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AN

ESSAY

ON

THE ORIGIN AND PROSPECTS

OF

MAN.

BY THOMAS HOPE.

IN THREE VOLUMES.

VOL. II.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1831

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ESSAY

ON THE

ORIGIN AND PROSPECTS OF MAN.

CHAPTER I.

Introduction to the modifications which of matter, first only inorganic and lifeless, render a part organic and living.

Many circumstances directly mentioned or implied in the Mosaic account of the creation, which at first sight seem to contradict the evidence of our senses, and to startle the conclusions of our reason, on more severe scrutiny seem perfectly conformable to the real course of nature, and to argue in their early author an acquaintance with that course—with the real data of physics and of metaphysics—more sound and deep than to this day the vulgar herd of men possesses.

Such is the circumstance implied in the words of Genesis, that light existed prior to the luminaries which are generally regarded as its first source: that the fixed stars and our sun were not the first dispensers of that light, but were themselves only among the later and more condensed aggregates and offspring of that light; first from earlier and more generally diffused sources in these bodies collected and rendered more perceptible to the sight, and, through the medium of these prior bodies, from them again to other heavenly bodies later and less capacious than themselves, transmitted—a thing which I hope already to have demonstrated.

Such again is the doctrine of the human species having first been formed out of the dust of the earth: if by that expression, "dust of the earth," we understand the elements before inorganic and lifeless, out of the combination of which other bodies organic and living were in their turn again composed.

Such again is the doctrine of man having first been in a state of innocence: that is to say, in a state in which, like the brute, he knew not yet the difference between good and evil,—in which whatever he desired, seemed to him good; before he began to acquire an insight in the more remote opposite tendencies of different actions, and to become aware that some actions beneficial to himself might not be so to others; and that some actions, at the moment grateful to himself, might not remain so even to himself, at a more distant period.

There are other circumstances, however, less conformable than these to the regular course of nature, which we still are wont to assume as facts, because we consider them at first sight to be asserted as such in Genesis; but which I do not think that a more exact scrutiny of its expressions, when taken in all their relations and bearings, exactly confirm.

Such is the doctrine of the Adam and Eve of which Genesis more peculiarly gives the history, having literally been the first created of human beings, and the only individuals from which descend all the varieties of the human race that at present exist on the globe.

Genesis itself, when different expressions in it, detached from each other, are approximated, seems to me to imply the reverse; since in contradistinction to the race of Adam, which the Bible expressly calls the sons—or favourites—of God, it mentions other different races, as the children of men; and states that among them Adam's first born, Cain, after having slain Abel, his second born, fled, and intermarried, and built cities, long before his own offspring could have wanted any; not to advert to a race of giants which Genesis mentions soon after.

Among the beliefs only founded on certain expressions in Genesis, misconstrued or misunderstood, and, as applied in their literal sense, contrary to the course of nature, seems to me to be that of the whole work of the creation having been achieved in six days, like those days of which, in the more central regions of the globe, seven complete what we call a week; and that of the seventh day having by the Author of that creation himself been devoted to a period of rest from his labours, like that repose which man seeks in order to recruit himself after his toil.

In the first place, the Hebrew word, translated in modern language by that of day, only means an indefinite period; and therefore cannot be accurately rendered by that of day, which signifies a definite period; and should in this instance be the less understood as having a meaning synonymous with that of day, since, firstly, the earlier works of the creation, achieved in certain of those periods, were said to be achieved prior to the period when time could, by the creaation of the sun, be divided in what we call days and nights; secondly, in different parts of the globe the sun itself causes the length of single days to vary from a few hours to half a year; and, thirdly, the things said to have taken place during the period designed by the term day, are described as having occurred during the interval between the evening and the morning, which we call not day but night: not to add that the work of the creation, so far from having, after going on uninterruptedly for six days, been suspended on the seventh, that work has not yet, as far as we know, from its first commencement to this day been suspended for a single instant; that the very act of adding to former periods of time, to former days, a new period of time, a new day, whether of labour or rest, implies a new act of the creation, and a new act of the creation teeming with as many other new acts of that creation, included in it, as there are new objects of nature produced in that single one; that that day which to man may be a day of comparative rest from the voluntary labours of the mind and of the body, must remain to God, who still continues to support that mind and body, as well as all else, a day of labour; that to God—if to him the creation, the upholding, the ruling of the things perceptible to man, be a labour—while nature goes on, while things perceptible have their course, while day continues, while the formation of entities proceeds, while the emanation of fresh time ceases not, there can be no rest from his labours, in the human sense of the word; that only when the advancement of the universe is entirely stopped, when nature herself stands still, and when time ceases to flow, God can be said to rest, in the sense in which the word rest is understood by man; and finally, that the very want—the very need—of such rest from his voluntary labours of body and mind as man can enjoy is a proof in that man of a weakness, unknown even to the more primary productions of God, and wholly inadmissible in God himself.

Among the beliefs, perhaps, not strictly deduced even from the words of Scripture, and certainly not founded on what we see in nature, is that of evil and death only having on this globe begun to prevail at a period subsequent to that of the existence of man; whereas the very first creation and movements of this inanimate globe, themselves already, as we have seen, only arisen out of prior irregularities that were permitted to creep in the conduct of earlier and higher parts of the universe, prior to the creation of our earth,—and themselves the more mediate causes of the creation of this earth,—must already, in the further development of this globe itself, and of the entities inorganic and organic vegetable and animal formed upon it, have necessitated the appearance of evil, decombination and death, prior to the very arising of man, and still more, to the period of any sin in man.

Among the ideas, from certain words in Scripture, or rather, from its silence to the contrary, very generally entertained, is the opinion that of a single restricted inland spot, supposed to have been situated in that part of the Asiatic continent since called Iran or Persia, and, like the later pleasure gardens by Xenophon seen and described in the same regions, named Paradise, having brought forth the first parents of all the living species which have since been dispersed over the land and the waters, throughout all the different other regions and climates of the globe—those species only able to live in the most extended seas, as well as those other species only capable of thriving in the dryest inland deserts: those since only fitted to exist nearest to the frozen poles, as well as those also only fitted to find their food where the sun has most power: those now only able to thrive on the destruction of other living entities, as well as those now harmless and inoffensive; and those whose first origin can now only be found in the prior decombination and dissolution of other prior sorts, as well as those now requiring for their appearance no such disgusting preliminaries: nay, the opinion of this single spot having brought forth the first specimens of all these future races from their first birth full grown and possessed of all their last and highest forms and faculties;—the vegetables expanded, and covered with leaves, flowers and fruit; and the animals fraught with immediate powers of locomotion, of feeding and of digestion: even the human beings themselves, as soon as they arose, endowed with powers not only of immediate sensation, thought, will and action, but even of reasoning, and of expressing their ideas in articulate and conventional language. It has consequently been thought that from the very first in the garden of Eden was seen to arise alike the hot spice of Sumatra, and the red fungus that only rises amidst eternal snows; the zoophyte and the oyster, only capable now of living chained to the rock in the abysses of the deep, as well as the eagle and the kite capable of darting across the widest regions of the sky; the whale of the ocean, as well as the camel of the desert; the elephant of the torrid zone, as well as the white bear of the icy pole; the insect that, now only permitted to live a single day, now dies the evening of that period of which the morn saw it arise, as well as the beast which for centuries drags on its useless life: the animalcule which, having no organs of generation, now can only arise out of inorganic matter, and cannot transmit its life to later individuals of its race, as well as the animal which, in a single day, can bring forth numbers of successive generations; the entities of the vegetable and the animal sort that can only, like moulds and mildews, the dry rot and the tenia, at present arise in the bowels or out of the corruption of other prior vegetables or animals—even those that can at present only spring forth from the decombination and decay of prior artificial compounds,—as well as those which can start up directly from the very freshness and fragrance of nature. It has been supposed that what first arose in this abrupt manner, at first was so modified as never to experience injury, decay or death: that, consequently, at first no leaf, no flower, no fruit, could be torn from the tree, be bruised by the tooth of an animal, be consigned to natural corruption; no animal be supported at the expense of a vegetable or of another animal; no lion or tiger feel inclined to injure a lamb; no horse or cow be suffered to nibble the grass; no entity to live upon any thing but inorganic and lifeless matter; supposing it even required the decombination of some such for its subsistence.

This state of things, however, which, while it lasted, and while it was destined to last for ever, left useless all the forms and faculties of entities organised and living, vegetable and animal, which have since come into play—if these entities in that state already possessed them—or which if while in that state they did not yet possess them, must in that state have still left them in reality wholly different from the entities that since arose, and still exist under the same denomination, however much we may still give it to the latter, could never on this globe have existed for a single instant, according to the present course of nature.

It is wholly out of that course that of organised and living entities, all at first brought forth in a single restricted spot and climate—of the most immovable and stationary plant, as well as of the animal most active and most nimble; of the entity most deprived of loco-motive powers, as well as of the entity possessing these powers in the highest degree; of the being most delicate as well as most robust—of the moss, or zoophyte, or oyster, as well as of the eagle and the hawk, either the full grown specimens or the first formed germs, after having during a period in paradise found a situation, a climate, a mode of existence suited to them, should each, across intervening elements most different from those it found in paradise, and thus most hostile to its support during the passage, be transferred to some other region, again different from both the former, in such a way as to become, not only during its progress so fitted for the journey, but at the conclusion of its travels so adapted to the new region in which it was doomed for evermore to settle, as thenceforth to leave no part of the globe, first wholly desert, and deprived of any of the races vegetable or animal which it was fitted to support; and which in their turn, now fitted only to live in that peculiar latitude to which they were transplanted, were now equally doomed to perish in those very regions in which they first arose. It is out of nature that the animal first only able in paradise to live on lifeless substances should by degrees only become able to subsist on prior living entities,—should become herbiverous, frugiverous or carnivorous; that the being first only formed for an inland situation, should be able to launch forth in the wide sea. To what use would first have served in turbot his fins; in the tiger his fangs: or when would first in them these supplements have arisen?

Besides these beliefs in things contrary to the course of nature, which probably only arose from our not understanding all the words of scripture in the sense in which they were meant—from confounding peculiar circumstances with generalities, and such like,—there are other accounts in scripture which in their literal sense seem so evidently averse to the present course of nature, that they can only be reconciled with this latter by being taken in a figurative sense: such is the account of the mother of mankind having fallen into evil and sin, not as the natural consequence of that state of innocence itself, in which nothing that tempts our desires by the more proximate gratification it promises, is suspected of having more distant evil tendencies, but by the direct instigations of an entity, for that sole purpose, by powers proceeding in the first instance from God himself, endowed with faculties of mind and body, which that entity does not naturally possess.

Nor can it be denied that, finally, scripture contains certain points which seem not only above our comprehension—a circumstance in our state of ignorance very natural—but even directly hostile to every suggestion which our reason represents to us as comprehensible.

How then are we, when between what our reason teaches us to be the course of nature and what the Bible relates as having existed, we find [illegible] opposition, [illegible] which [illegible] believe, [illegible] doubt or to disbelieve.

[illegible] answer, that considering Genesis [illegible] elaborate [illegible] development [illegible] be [illegible] those of a life hereafter—are not even mentioned in the Old Testament:—

Considering that among that nation, from its ignorance and poverty of abstract terms, symbolical and figurative language was still so prevalent, not yet as a means only of ornament but as a matter of necessity, that the author of Genesis, after having made the immateriality of God, his exemption from all the attributes and imperfections of matter, and the impossibility of representing his essence by material and sensible means, the chief and leading point of his precepts and doctrine, is still himself continually, by the force of habit, betrayed into representing that God is endued with human limbs and features, and swayed by human feelings and passions:—

Considering that the points most important to our guidance and welfare—those which the Bible was most directly or principally intended to inculcate—such as that of the unity of God, the immortality of man, and the importance to the happiness of that man here and hereafter, of his living in love and charity with his fellow creatures, all are points which stand equally whether we take certain adventitious narrations in a literal or in a figurative sense—as fact or as fiction:—

Considering that in the original text of the Bible there are many passages so contradictory to each other as to render it absolutely impossible to adopt them alike in a literal sense, and that we can only adopt some in a literal sense, by adopting others in a figurative sense, or by rejecting them altogether:—

And considering, finally, that the very idea of being bound to take the whole of scripture—the parts of no practical tendency as well as those of the greatest practical consequence—alike in a literal sense, may startle certain minds weak, but tenacious of their opinion, to such a degree as, in their dilemma and despair of reconciling their belief and their reason, to tempt them to reject the very precepts of scripture most important to their future happiness, both here and hereafter, I think it best and wisest to confine our implicit faith only to the articles which, influencing our actions, must through these actions influence our eternal felicity: where the silence of scripture alone, or an exaggerated stress laid on certain of its expressions in preference to others, would lead us to infer things contrary to the course of nature, not to suffer ourselves to be, by any excessive love of the marvellous, where there is so much reasonably to marvel at, induced to take in a mystic and preternatural sense, what, with some exertion of the reasoning faculties, may be taken in a natural and rational sense: where the words of scripture, even in their most limited natural sense itself, imply any thing contrary to the course of nature, there to understand them by preference in that allegorical sense, in which it was ever the practice of the East to convey lessons and to inculcate truths; and where between the two different senses given to the same words,—the natural and the figurative sense,—we are no longer permitted to retain the option; where we can only adopt the words, relating facts contrary to the course of nature, as they stand, or reject them altogether; where ultimately there remains no medium, no evasion, no subterfuge, no rational explanation in words of one language ill rendered in those of another—in an allegorical or hyperbolic sense—where we come to a positive conflict and contradiction between nature and the Bible:—where we must either, accepting certain words in scripture literally and as they stand, reject the universal testimony of nature, or vice versâ: where thus we have only the option to believe what repugns to our intellect, or what seems in every respect to glide most easily into the same, and to be most consistent with analogy, then, in respect at least of such doctrines as cannot influence our deeds, our practice, our actions, to do what in fact we cannot—strive as we may—help doing: only believing what we can, and in so doing console ourselves, for what more we cannot believe, and keep our conscience quiet and absolved from guilt, by the idea that a tradition only received on a secluded mountain by a single man, who durst not raise his eye to its author, and who transmitted that tradition in an artificial and conventional language of man's own making, and from whom moreover it has only circuitously, through multitudes of intervening centuries, and millions of intervening men, with all the liability to mistakes, errors, interpolations, prejudice and pious fraud, to which all human productions ever remain liable, descended to us, must after all be less authentic, and seem less certainly to contain the genuine will of the author of nature, as to what we are to believe of his acts and intentions, than the language of nature itself, to this day from the author of nature coming to us as pure, as unadulterated, as directly, and as free from corruption, as it did the first day it was promulgated.

By such a method, only founded on the sincerest love of truth, I shall guide my credence, at least in those matters in which that credence can have no direct influence over my actions, as is the case with that respecting certain points of natural history touched upon as well in as out of scripture: of the former of which I shall just mention a few more which I think unfounded, before I pass over to what I believe the real truth.

Some people maintain that in paradise there could only have been placed entities living and sentient which from their very first commencement were full grown, matured, and in possession of their last and highest faculties; because, if without parents to rear, to feed and to protect them, they had in that paradise been first produced and placed in a condition more incipient and less matured, such as that in which in the womb of their earlier parents first begin the later offspring of such entities, they could have found neither support for themselves, nor protection against their natural enemies. A mighty fine reason indeed!

Who that reflects does not perceive, firstly, that where the elements, substances and materials, necessary spontaneously to form the first rudiments of entities living and organized, have been supplied and scattered about in quantities sufficient to be able, without the assistance and medium of prior parents of the same sort, to form these first rudiments of actually existing entities, these elements might also have continued to lie about and to be supplied in quantities sufficient to continue being by these first entities involuntarily absorbed, till these entities were by them carried on to that age, maturity and vigour, at which they became enabled to seek their further supply voluntarily, in sufficient quantities if nowhere else, at least in the very bowels of other different entities, organized and living, composed sooner of the same elements and substances with themselves; and secondly, that where, as must have been the case while, from the abundance of elements of entities living and organized thus far unappropriated, the first of these entities spontaneously arising must in different places first simultaneously have arisen in very great numbers, if some at last became by others destroyed and decombined, others, that destroyed and decombined these first, would thereby at least themselves continue to live, and to be supported sufficiently, by degrees to become able themselves to perpetuate their race: nay, that if by some accident—some revolution of nature—the whole of any or of every living species again became destroyed and decombined, as long as its elements remained or were reproduced, the same causes that first had occasioned these to be spontaneously combined into actual organized and living entities, would make them afresh in due time recombine into such?

Not only men ignorant and short-sighted believe that the first parents of all species organized and living, vegetable and animal, have arisen at least in part out of a principle different from and independent of any principle found in mere lifeless and inorganic matter; but even men of investigation and science frequently consider entities organized and living to have derived their organization and life from a principle totally different from any principle that could have proceeded from their lifeless substances and forms: they believe that an intransgressible line of separation divides all entities, or at least all the parts of such entities that are inorganic and lifeless, from those that are organic and living: because they entertain concerning life and organization a number of other errors of which this latter opinion is the direct consequence: —

Because on the one hand they believe that all bodies inorganic and lifeless, unto the last and highest, in all their component parts by mere agglomeration directly from without, not only are first formed but to the last continue to be increased; that none of these, by elements, first from opposite sides without made to penetrate more inwardly, and there to meet, consolidate and cohere, first formed, are afterwards, by other elements from without, following these first inward, are next, on meeting, from within again made to recoil and to circulate more outwardly, before they are first permitted, round the former ones, to consolidate and to cohere; and are thus, from a lesser nucleus within, made gradually to increase and grow more outwardly; that these aggregates still inorganic consequently in them offer no lasting succulence, no growth of a gradual sort from within at all, no power of driving substances outward, nor no faculty of replacing these substances driven outward by new ones coming in from without, no renovation whatever; that what began in lifelessness and want of organization cannot in time and by degrees pass over into a state of organization and life; that entities first inorganic and lifeless, while they last and grow, to whatever dimensions they extend, must still ever from first to last remain wholly separated from and unconnected with entities organic and living; whereas on the other hand they believe that all entities organic and living, from their earliest beginnings all equally distinct and separate from all inorganic and lifeless aggregates, and from the first have that succulence, that circulation from within, that gradual growth outward, that replacement of substances driven outward by other substances from without coming in, that renovation of substances and parts, which substances and bodies first inorganic and lifeless never—as they imagine—acquire; nay, that even after a time all living entities, to the parts wholly cellular which certain bodies still inorganic already, as we have seen, possess, are made to add parts vascular which no bodies entirely inorganic yet display: because they think that while mere inorganic and lifeless substances to the last remain wholly homogeneous in nature and in form—that while minerals never, to their original elements and combinations, add new and different substances and forms—all entities organic and living from the first show substances and parts different from each other: that while all mere inorganic and lifeless substances remain to the last sterile, unproductive and unable to continue their race in new individuals of the same sort, distinct from themselves, all organic and living individuals after a time acquire the power of propagating their species by a new progeniture, which detaches itself from the original stock, and commences a separate existence; and finally, because they believe that, while no aggregates inorganic and lifeless have any definite period of decline and death, all entities organic and living whatever are necessarily doomed, after a certain period of life, growth and expansion, to experience as definite a period of decline, death and dissolution.

These beliefs, in themselves unfounded, as I shall presently show, have in their turn produced other later beliefs as unfounded, and which have become more evidently absurd and preposterous than themselves, such as that of every entity, which from the first cause and creator had by the express creation of a new principle of organization and life, wholly distinct from any principle already found in mere inorganic and lifeless matter, and only experiencing further development in organized beings, received organization and life, having, moreover, in order to avoid the fresh repetition of similar express new creations at the commencement of every new entity organized and living vegetable and animal which appeared on the face of this globe, from the first parents of each living species which appeared on it, been transmitted to, and inherited by all their later descendants, that could at any time arise in any part of this same globe: so that all the parts of these latter, not partaking of this principle already existing in their first parents, which should by degrees appear in any of these later descendants, should only be mere inorganic and lifeless ekings out.

But if this had really been the case, of every primitive individual living and organized that had been created, every later descendant, simultaneous with, or successive to another, which actually arose, or might have arisen to the end of the duration, and to the ultimate limits of the space presented by this globe, must have carried off a fresh portion of the organs included in and possessed by the first individuals from which it descended; and must thus either at each remove from its predecessors or first parents, and at each fresh subdivision of the organic parts of these, have singly of these organic parts retained a smaller portion, and have singly been less in general size; or can only have retained the same general size with these, by being individually formed of fewer organic parts, and by being made to add to these fewer organic parts a greater number of mere ekings out and expletives.

Above all, where parts organic and living had been cut away, destroyed, or wasted, no entire new ones of the same sort, not transmitted by or inherited from the first parent of the species, could subsequently have replaced them. By no injury inflicted on the organic structure of a living entity, calculated to give its saps a new direction, before unseen in the same, or by no intervening of certain substances of one sort of entity with certain substances of another and different sort of entity, could there have been produced any new parts organic and living, different from any former parts seen, and yet, not only in themselves as fully organized as the former, but having their different organization as fully and organically connected with that of the former organized parts themselves, as if they had been of the same sort.

Yet all these circumstances, which by the very principle here set forth of all the organization of each living species being included in its first individuals, and being, in their later descendants to the last, only limited to what they inherited from these first, are represented as impossible, are seen to happen every day.

So far from every individual of each species, as it becomes further removed from its first parent, showing organs fewer in number and smaller in size, or at least ekings out and interpolations of mere inorganic matter more numerous, if by chance it happens to be placed in a situation or soil more favourable to its luxuriance and development than any its former parents more proximate or more remote, will throughout its more extensive parts every where show an organization more fine and full and close.

In the individuals of many species, for each organ of a sort forcibly removed, a number of others of the same sort, entirely new, for which there would not have been room if the first had remained, will spring forth, and will extend and ramify without end or limits; as we see in clipped hedges, and in fruit-trees pruned.

Many an animal only destined originally to have one head, and one tail, each at an extremity opposite to that at which springs forth the other, and one set of lateral limbs at the side opposite to that whence branches forth the opposite corresponding set, will, if it loses these, bring forth a new organ or set of organs of the sort, not in its more regular and uninterrupted development wanted: nay, will, if the direction of its component fluid be wholly subverted, at both extremities alike produce heads only or tails only, and on both sides produce a superfluity of limbs.

Many a flower which usually only exhibits a small and a definite number of petals, may, by a superabundance of food, have the number of these petals indefinitely increased. Reverse the situation of certain plants, so that the parts which first faced the air shall face the earth, and that those which first faced the earth shall face the air, and from the extremity whence before would have arisen fresh leaves, will arise roots, and from the extremity whence before would have arisen fresh roots, will arise leaves.

Let a plant or an animal be attacked by a blight, or punctured by an insect, the influence of whose new substances poured in it generates a disease, and it will be made to bring forth, the former some burr, or bladder, or fungus, or gall-apple, and the latter some excrescence, some pimple, some wart, some piece of proud flesh, unexampled in any former entity of the same species, whose development has not by some strange influx been disturbed, and yet throughout as fully and closely organized as the parts more sound and in the former vegetables of the sort regularly brought forth.

Finally, intermix in an individual of a peculiar species with the fluids belonging to it, the fluids belonging to another different species, and there will frequently from the union of these two different fluids arise a hybrid, not only in the parts different from those of either parent as fully organized as in those parts which it inherited from each of these, but even in the intervening links and junctures derived from neither parent exclusively and only derived from the mixture of both, and thus different alike from either singly and separately, as fully and completely organized as it is in those parts which it derived from either parent exclusively.

Now, these circumstances attending these later organizations in part superstructed on and arising out of earlier organizations, so different from those which must have attended these organizations, had there existed a positive line of demarcation between bodies still entirely inorganic and lifeless and bodies organic and living;—had the first bodies organic already necessarily included in them all the essential organic and living parts of all the other later entities organic and living that might in the course of time have proceeded from them,—and had thus in these bodies organic and living and in their descendants any later influxes from without, however much of these the intrinsic nature and relative proportions might still have remained similar to, or again have differed from those of the former influxes, still have left the first aggregates organic and living that arose out of them similar to those that were before,—these circumstances by which on the contrary, according as in these bodies by degrees flow from without new substances, in their nature, quantities and proportions similar to or different from those that flowed in them before, they are again caused to compose later forms organic and living, either still similar to or again different from the prior ones,—prove not only that as the later combinations of substances thus far singly inorganic and lifeless remain similar to, or again change from former ones, the later forms and faculties organic and living arising from their combination also remain similar to or become different from these former ones; but, moreover, prove that only from the peculiar combinations of substances before inorganic and lifeless can arise any aggregates organic and living—that only on the peculiar combinations of these substances before inorganic and lifeless must depend whether their combinations in solid and cohering bodies shall remain inorganic and lifeless like themselves, or shall become organic and living.

And this truth already a priori established, is by experience—by a sedulous inspection of the course of nature—confirmed, since, instead of their ever remaining between substances inorganic and lifeless, and between bodies becoming organic and living, a definite and a lasting line of demarcation, the former often by an insensible transition run into the latter: since, if on the one hand there be many species of bodies which, like snow-spangles and like pyrites,—the former only out of separate substances by the mere force of cold, and the latter also by the intervention of the force of heat,—composed, though they are already regularly from within made to grow outward in bodies insulated and detached from other surrounding solid aggregates, and showing in their own internal crystallization and forms a perfect symmetry, yet soon have their further growth arrested, and show no further marks of organization, life and growth, and still less of change and development of forms and faculties, and thus are called lifeless, on the other hand we see out of certain bodies themselves still decidedly inorganic and lifeless, such as certain species of stone and mineral, as out of their proper matrices, arise and grow, and to the last naturally continue to cohere with these, certain other bodies still like asbestos, by the custom of language called merely mineral, inorganic and lifeless, which nevertheless, by new fluids constantly flowing in and circulating through and consolidating and cohering with their former solid parts, and thus making them extend and grow, not only on former masses inorganic and lifeless superstruct in unbroken cohesion with them other later parts having all the essential attributes of organization, life and growth, but at the same time render it impossible to mark exactly where inorganic and lifeless masses cease, and where out of them arise bodies organic and living.

And should it be asked why, if to this day, not only where organisation and life already exist;—where individuals, vegetable and animal, already possessing the attributes of organization and life, already have been brought forth and flourish,—later influxes from without of matter thus far uncombined, inorganic and lifeless, or after having been combined in bodies organized and living, again decombined, disorganized and dead, can of this organization and life cause the further support, extension, development, increase and even change, this organization and life cannot from bodies thus far inorganic and lifeless, by peculiar combinations take their first beginning and formation;—why from nothing yet that is organized and living do not actually to this day in our very presence and under our very eyes arise such spontaneous forms of organization and life vegetable and animal, as might assure us undeniably of their possibility and of their taking place, I shall answer firstly, that in no spot whatever any entities organized and living, except such as out of the elements thus far inorganic and lifeless by the peculiar atmosphere and soil—the peculiar climate and substances of that peculiar spot,—can be supplied, and be made to meet and to combine in the relative quantities and proportions adequate to the purpose, can spontaneously arise: that still at the frozen poles the bleak sky and the torpid earth cannot be made spontaneously to furnish the elements, thus far inorganic and lifeless, only capable of being consolidated into the forms organic and living, vegetable, animal, only able to arise out of the meeting of the richer elements, aerial and terrestrial, that can only be supplied from air and earth between the tropics: and vice versâ.

And secondly, that moreover, where already of the different species organic and living, vegetable and animal, congenial to each spot, not only the earliest, simplest and lowest, but the very highest and latest sorts the materials have already for ages, not only spontaneously, but through the medium of the action involuntary and voluntary of prior individuals of the sort already existing, and through the channel of regular procreation, been made to meet, and to produce the forms of later individuals of the sort, to the full extent and number to which by these means the inorganic and lifeless elements existing, necessary for the purpose, could be made thus to assemble and to produce these:—where consequently from this circumstance the elements necessary for the combination, even of those higher entities, vegetable and animal congenial to the spot, have in their uncombined and inorganic state already become too much exhausted, too thinly in their inappropriated state left scattered and floating about, to be spontaneously, and without the action, the assistance and the superior attraction of earlier individuals of the same sort already existing and formed, made to continue meeting and combining into new individuals of the same sort,—where thus it required all the action, assistance and superior attraction of entities of the same sort already existing and formed, to bring about the formation and combination of fresh portions of the same substances, even in new additions to the organs of the entities already formed, and still more form such substances altogether still thus in entire distinct new individuals of the sort, it is only in prior individuals of these same high sorts that the elements of new individuals of the same sort can be collected in quantities sufficient to lay the foundations of such actual new and distinct individuals of the species, subsequently, from want of room, by these former ones expelled and made to commence a separate existence; and it is only of these elements thus far yet inorganic and lifeless produced by the soil and climate, of which a smaller number suffices to be more hastily combined into entities organic and living, vegetable and animal, more insignificant, such as hardly perceptible mosses, lychens, and grasses, and animalculæ, worms and insects, whose existence excites little attention—which when they are not combined are not missed, and when combined excite no question, whether they have been combined spontaneously, or through the medium of prior parents of the same sort,—that at such a late period either enough can be left, or can again, by dissolution and decombination of prior organized and living entities vegetable or animal, be afresh dispersed and recast into circulation, to be in our very presence and under our very eyes again spontaneously recombined into new entities organized and living.

But I shall add, that wherever in a spot from the sky descends sufficient warmth, and from the earth ascends sufficient humidity to meet each other, and, when left long enough undisturbed, to join and to combine into any productions vegetable or animal, some such productions, organic and living, vegetable or animal, suitable to the soil, infallibly still to this day arise in quantities and numbers exactly proportionate to the materials from above and from underneath supplied, and made to meet for their production: witness the mould, mildew, mosses, weeds, grasses, and other minor vegetables; the aphides, the musquitoes, the worms, insects, and other minor animals, which, in every spot where from air and earth a sufficiency of the elements necessary to combine into such, are made in a place sufficiently resisting their pressure to prevent their escape, and to favour or force their union, by degrees are seen to arise, though the volatility of their elements before they are out of these produced, and their minuteness and insignificance when first produced, do not allow us through the sense directly to acquire the least certainty of their formation being spontaneous, and not being produced through the medium of prior parents of the sort.

Having thus shown that there is no necessary line of separation between substances in a state unorganized and lifeless and between substances organic and living—that on the contrary it is out of the meeting and combination of substances before inorganic and lifeless in peculiar relative proportions alone, that bodies organic and living may, nay must, necessarily arise; I shall now proceed more pointedly to show how it is that out of certain different substances separately inorganic and lifeless, bodies organic and living, vegetable and animal, first spontaneously arise.

CHAPTER II.

What are the circumstances which, while some aggregates of a crystalline species remain inorganic and lifeless, cause others to become organic and living.

Of aggregates of substances still in their whole so fluid that they cannot yet by the resistance of their molecules to the pressure of new substances, from without driven and penetrating within them, be made to preserve any definite form and arrangement, no part can yet be called organic and living.

But molecules may already cohere sufficiently to offer to certain other later fluids and substances, from without driven to and in them, athwart their aggregate a definite path, or to force these to be within them condensed in certain definite later solid forms, though to our ruder contact they still so yield as to remain and appear, to our organs, wholly fluid.

Such are many substances mineral, vegetable, and animal, by us still called fluid, which nevertheless already without the intervention of any solid parietes, resist the penetration of other fluids running alongside them.

However, of substances, already by combining electricity and by cold congealed, consolidated, and rendered cohering and crystalline, or such as to present a cellularity composed of alternate parietes and intervening interstices, some may, like snow spangles, like rime, like ice, like salts, and like all other mere mineral concretions, remain entirely inorganic and lifeless, and others, like these former still only solidified in a mere cellular form, and entirely bereaved of vessels, may already, like asbestos, like mosses, like zoophytes, and like all other later and more complex entities, vegetable and animal, become organic and living and growing.

On what depends between the former bodies merely inorganic and lifeless, and the latter bodies organic and living, the difference which leaves in the former a total absence of organization, life and growth, and to the latter first gives the possession of these new attributes?

It only depends on this, that in the former bodies, when their first molecules from opposite sides driven together and meeting are made to consolidate and cohere sufficiently to have of the new substances still fluid that enter and penetrate between them, by the pressure of electricity of a combining sort and of cold from without, and by the resistance or counterpressure of the former solids from within, a portion again stopped, condensed, congealed and made to combine and consolidate, of these new substances from without, during their consolidation the pressure on the former ones within already consolidated, so exceeds in these former ones from within their elasticity or power to yield to that pressure of these outer ones, without being by it broken, dispersed, and decombined, as not to be able themselves to remain solid and cohering, while these new ones are added to them;—as we see in stones which when humidity driven into them is there by combining electricity and cold congealed, it soon makes them burst and themselves again decombine;—whereas in the latter bodies, when of the new fluids driven in them a portion is stopped, congealed, consolidated and made to cohere together, the extension which these new fluids experience in being consolidated in crystalline forms, disperses not by its pressure the former solids, nor decombines these entirely, but by the elasticity these possess only makes them also in their turn extend, till by their extension they again exert over the new ones consolidating a counterpressure, sufficient to make these also cohere even with themselves, and thus gradually increase the general mass of substances solid and cohering, in so doing, make it exhibit the phenomena called of life and growth.

So superior indeed is the elasticity of all bodies organic and living over the elasticity of bodies not organized and still lifeless, that a blow which entirely severs in twain and breaks a bar of iron, will often only, while it lasts for an instant bend a vegetable filament, or animal fibre, which again resumes its former shape as soon as the pressure is removed.

Not, however, that the force of combining electricity and cold, even when in its simplest shape consolidating the later fluids penetrating in the prior solids of vegetables or animals, may not in these produce such distention as to cause decombination; but this force must for that purpose be much more intense relative to the solids on which it acts, than that in which it suffices to produce this effect on inorganic and lifeless bodies.

On what circumstance again must in certain solid bodies depend that elasticity so much greater than that possessed by others, which, when they take in from without new fluids, and when these new fluids within them consolidate, prevents them from being themselves by their pressure in consolidating broken and dispersed, and only suffers them to be by this pressure so extended as by their counterpressure to make them cohere with these new solids, and thus live and grow?

Not in these solid bodies being entirely formed of new elements differing *in toto* from the elements of the former solid bodies still inorganic and lifeless; for of the elements and substances composing all bodies still inorganic and lifeless, a portion still necessarily enters in the composition of all bodies organized and living. In bodies organized and living as well as in bodies inorganic and lifeless, still is required a certain portion of time, of space, of gravitation centripetal and centrifugal, of electricity combining and decombining, of cold, of heat, and of substance, such as light, colour, savour, and odour, partly radiant, partly gaseous, and partly liquid, which finally become cohering and solid.

But as in bodies inorganic and lifeless these substances are not mixed with a certain portion of other substances, with which they are mixed in bodies organic and living, they are themselves in the former, in proportion to the general density and size of these bodies, in greater quantity than they are in the latter. These bodies have of these substances a less quantity in proportion to their general density and extent than the former possess.

And it is the greater number and variety of molecules of different elements and substances, possessing different definite size and shapes, combined together in the crystallizations of certain solid bodies than are combined in those of others, which causing in these latter, between these solid molecules, interstices and pores more minute and more varied, more extensible and more compressible, without breaking, than are the former solid bodies, that superior elasticity, that power of returning the pressure they receive by an adequate counterpressure, on which depends, when new fluids are driven to and are made to consolidate in them, their faculty of being by these not broken, dispersed, and decombined, but only made with these new substances to cohere; and thus to live and grow.

That this supposition is true is confirmed by all the bodies that show organization and life, showing, mixed with a portion of the same elements and substances, indispensable to those that possess not yet any such attributes, a portion of certain other substances, of which the former possess not yet any portion whatever; vegetables already showing not only mixed with their oxygen a greater portion of carbon than is possessed by mere minerals; and animals again, having in them a greater portion of nitrogen than is found either in mere minerals, or even in vegetables; so that each of these later species of bodies again have a certain portion of certain substances, of which the former sorts are entirely deprived.

I have already in solid and cohering bodies of an inorganic and lifeless sort observed, that further pressures from without may drive new elements and substances to them, and may be let into their interstices; but I have forgotten in these solid and cohering bodies of an inorganic and lifeless sort to observe, as I ought, that besides the force from without which impels these substances to those bodies, there arises in these bodies themselves a force from within which attracts these substances from without to them. It is that force which, preventing the penetration of these substances from without, where exist the solid particles of these bodies, causes their being all determined to the intervening interstices and pores; and there enables them, by these interstices protected from all sides, to be drawn in, more partially, but with greater strength than before; and it is called the force of suction.

This force, already acting in solid bodies of an inorganic and lifeless sort, moreover in bodies organic and living, whose solid parietes and intervening pores are both more minute and more numerous, even where the pressure from without inwards becomes not greater, from within acts outward with more intensity, and thereby makes these solid and cohering aggregates of an organic and living sort by degrees suck in the substances which from without present themselves at the orifice of their pores, with greater avidity and in greater quantity, than do the pores of inorganic entities.

It must already have appeared, that the first and most fundamental attribute of organization and life, namely, that of molecules of substances themselves already condensed and cohering in a solid body, so pressing on new substances driven into the interstices or pores of that body, as in these also to be made to solidify and to cohere with each other and with the former solid mass, and still to increase that mass, and make it grow, is a circumstance which cannot be fulfilled in a single undividable moment, and must depend upon a certain length and succession of time: and as of new fluids from without the influx, penetration, solidification into new solids, and the assimilation of those new solids with the former solids already aggregated, is more slow or more rapid, more rare or more copious, vitality is in an entity still said to be more slack and feeble, or already to be more intense and forcible.

In some entities vitality may still be so slack and slow as by its imperceptible changes still to elude our senses, unless the entities be examined at very great intervals. In others it may be so rapid, as by its accelerated movements to strike our eye in a few minutes.

While in bodies new fluids are only made to penetrate, to condense and to cohere with each other and with former solids, without decombining and expelling any of these former solids, the bodies only grow slower or quicker, but indefinitely, and without experiencing any marked period of decay or renovation.

But in bodies composed of peculiar substances more fine and varied, while of certain of the prior solids from within the resistance and counter-pressure causes of certain of the new solids from without the cohesion with and addition to them; of certain of the new solids from without the pressure inward, of certain other of the prior solids within again causes the loosening and decombination from the remainder, and through the pores and interstices between those that still cohere, their expulsion and driving out of the body: so that in the same bodies organized and living in which, on the one hand, there is a continued partial influx, combination, life and growth, there is at the same time, on the other hand, a continued partial decombination and deperdition, both going on together.

And these two opposite movements and tendencies may and do already coincide even in the seeds of the minutest vegetables, and in the ova of the most imperceptible animals.

While, however, the exit and deperdition are only partial, and while new substances coming in still continue supplying the place of the old ones going out, the body still experiences constant renovation: and even as long as the influxes exceed the effluxes, this renovation produces continued growth.

In many living entities there however comes a time when the force from without that makes them extend, is balanced by the force from within which resists their further general extension: then they no longer externally grow, but the substances driven in may still continue for a time to have its solid molecules packed closer, so as to acquire greater density and vigour: and as long as the substances coming in and those going out continue on the whole to balance each other, the body is said to be stationary. When at last the prior influxes from without produce in the interstices between former solids a density and closeness so increasing as to obstruct and impede the penetration of later new influxes from without, and when consequently the quantity of the substances from within driven out begins to exceed that of the substances from without driven in, the body is said to begin to decay.

Finally, when the decay becomes general, when no part continues from new fluids coming in to experience fresh renovation,—when thus all the faculties of life entirely cease,—complete death ensues.

I say complete death, for from the very beginning of life may already on the one hand begin partial death, while on the other hand there still continue partial life and growth and renovation: and it is only when of an entity no part whatever remains able to live, that it is completely dead. In brutes and in human beings death may already commence from their very issuing into light and may not yet be complete, even after they are again laid low in the grave, when the fur of beasts and the hair of man often still live and grow, till all further sustenance is denied them.

The word dissolution is generally coupled with that of death: still is not dissolution always the immediate or necessary consequence of death. Death consisting in the cessation of the faculty of making new solid parts cohere with the former ones—of the faculty of life,—may still only produce the mere immobility and stationariness of the parts already cohering; may not yet be immediately followed by the dissolution of those parts. Death only in entities that have lived consisting, in the first instance, in the loss of the power of living—of further combination,—it is only after death the inrush of new fluids which, when not consolidating in the body, but fluidising the solids already in it produced before, first causes general dissolution; and this inrush often may be and is prevented.

Already the sun, the planets, and the other heavenly bodies to a certain degree solid, which from without take in certain substances, and of these substances cause a part to circulate through, and from within them again to issue outward, each possess two sorts of atmospheres: the one of the substances penetrating within them, and the other of substances again going out of them; each less or more copious, as in them exists a vitality less or more intense and active.

The atmospheres coming into and going out of our sun—a body experiencing an absorption, circulation, movement, change and exhalation very copious and constant, and such as itself feeds every other body of our planetary system —are very intense and active.

The atmospheres coming into and going out of our moon—one of the bodies of our system experiencing an absorption, circulation, movement, change and exhalation very languid and slack—and being probably in its internal parts very solid and stationary,—are so feeble, that it often has from this globe appeared doubtful whether the moon had any atmosphere at all.

Of our own globe, the different solid bodies even inorganic that between their parietes have interstices or pores, through which from without substances still fluid enter, penetrate, circulate and again issue, already all have atmospheres, but still very intermittent, weak and attenuated.

On this earth the substances radiant, gaseous and fluid, more copious and varied, that are constantly driven to and left to penetrate in, to circulate through, to consolidate with, and again to decombine and drive out the former substances of bodies organic and vital, must on the contrary cause an atmosphere coming in and going out of these organic bodies, more copious and constant than any bodies inorganic and lifeless can display; but in these latter, as in the former bodies, the atmosphere absorbed inward always retiring from us, and evading the touch, can spangles of snow or the congelations of rime, though the former already from within expand in the concentric radii of a flower, and the latter in the diverging ramifications of a plant; because their growth, accomplished in an instant, is of short duration, and when once it ceases, does not recommence: it may already begin in the filaments of asbestos, which seem to grow during an indefinite period; in the dots or flakes which light, heat and humidity combined by degrees form and extend, under the name, I believe, of lepra, over the panes of a piece of glass which has long remained unwiped; in those green incrustations which the autumn's damp brings forth from stone; or in a thousand other bodies, having a perceptible and a gradual and a continued increase and growth.

As all the solid formations of this globe, mineral, vegetable and animal, first arose from fluids, the French naturalists of the present day, rather, I think, confounding fluids, among which still belong gases, with liquids which must be later compounds of gases, seek in the remains of that sea which once covered the whole surface of the earth, the earliest and simplest solids, not only inorganic but organic and living, vegetable and animal. They there trace them in the mucous matter which first solidifies in the mere cellular form of the chaodiniæ, the ulnaceæ, the confervæ, the laminariæ, the fuci, the hydrophytes, and the other vegetables which the sea produces, and many of which, in their great toughness and in their brownish hue, resemble thongs of leather. They consider all plants growing nearer the surface of the earth, and wanting more air, as of a later date. But air, composed of various gases, has preceded water as well as land: and of these gases many may have been in that very air, without the medium of water, condensed and combined not only in solid bodies of an inorganic and lifeless sort, such as hailstones, snow-flakes, ærolythes, &c. which only afterwards their growing cohesion and gravity impels to and causes to form and to increase the solid nucleus of the earth, but even in bodies of an organic and living sort, such as the epidendra formed in air, which when heavy enough to fall, attach themselves to bodies inorganic or organic rising from the earth, that serve them as supports and fulcra for further growth; and still more evidently those aphides, which, after one of those collapsions of elements called a blight, generated in air, often put forth wings which continue to support them in that air, without at all reaching the solid bodies growing from the earth upwards.

Mere gases however can in air, or even in water, be consolidated in bodies organic and living which, while remaining in that element without any support afforded by a substance more solid, are liable to be by winds or waves buffeted about, and less able to take a firm root, and to enjoy in their infancy a screen, a protection, a hold, a resistance and a fulcrum, than those formed nearer the solid bodies of the earth: but only the minuter or lighter ones remain in that air, and those which grow larger, denser and heavier, soon seek either the earth itself, or the earlier organic solids rising from the same.

Like the materials of globes themselves, the materials of all the lesser organic aggregates vegetable and animal that again arise round these globes, beginning to derive their solid form from converging gravitation which, from all sides without presses more equally upon them, before diverging and centrifugal gravitation from within again makes them expand more partially outward, first appear agglomerated in the more lumpish and huddled shape, the vegetables of a seed, and the animals of an egg, before they again show any more partial ramifications outward.

CHAPTER III.

Why do bodies, as they become more fully and variously organised, in a sound and healthy state, let out more heat?

THIS question has puzzled people very much. Methinks it admits of a very easy solution.

All substances, while in that state of fluidity which precedes a state of combination, imbibe, intermixed with that electricity of a combining sort which on emission produces a feel of cold, a great deal of electricity of a decombining sort which on emission produces a feel of heat. When by the electricity combining and productive of cold they are combined, that electricity decombining and productive of heat is again driven out, and made to penetrate into, and be felt by the organs of sensation. Thus already the fixed stars and the sun are made in their constant combinations to send out a certain degree of heat, of which a portion reaches, and is felt on our earth.

When the substances round our earth itself are consolidated and made to cohere in solid bodies, the heat which was in them mixed with the cold, is likewise partly driven out; but as the consolidation of mere mineral inorganic and lifeless bodies only takes an instant, the extraordinary heat which is evolved during the act of that mineral consolidation also only lasts an instant, and soon again disperses; when only the cold which in the body consolidated has superseded that heat, is, on touching the same, partly evolved and felt.

Even if new heat from without is afterwards again made to penetrate into the body cohering and consolidated, it only tends, when great, to its decombination and dissolution, and at any rate is only, while it overflows and again is partly suffered to escape from the same, by the organs of sense perceived and felt.

Not so does it fare with solid bodies of an organic and a living sort. In these the case is different. In these of elements and substances coming from without in a fluid state, the solidification and the union with former solids is permanent, and so likewise is with it the evolution from them of that heat which was harboured in them prior to their consolidation.

Thus it is that already the simplest plants not from a heat, produced only in them by later application from without, but from a heat already from without renewed, whenever new substances from without still continue to penetrate in them and to increase their growth, evolves portions more copious and more lasting than after they once are consolidated do evolve mere minerals: that in plants, as they have a vitality more active and rapid, this heat which they evolve still increases; that in animals, in which fluids from without more various combine and consolidate, this heat again acquires greater intensity; and that in animals themselves, finally, as they are of a higher sort, and become more complex, this internal heat they collect and evolve again becomes greater. They are only a focus which constantly from without imbibes imperceptibly, and again emits from within, perceptibly, a greater quantity of heat.

When organic and living bodies, from first being sound and in good health, and causing new substances flowing in them to be combined rapidly, and thus to evolve much heat, by degrees fall into bad health and disease, and thus cause new substances flowing into them to be combined more slowly and imperfectly, they take in from without, with a smaller quantity of substance, a less quantity of heat; and this heat again by the cold from within less constantly kept in motion and evolved, makes them feel aguish and chilly: until this heat, by its own greater concentration and by the additions of other later heat from without which continues to enter and to be added to it, again from within obtains a sufficient preponderance over the cold that kept it confined, to be able athwart that cold and the fluids which it kept condensed, to break forth, to occupy, and fill the body, to be felt by it more generally, and to drive out the cold and the congelation by it produced, in the shape of copious perspiration.

In tropical climates where the general atmosphere remains more fine and more elastic, and receives greater quantities of the radiance both of heat and cold from the sun, and of the pressure of gravitation from the moon, not only from the tides of the sea, but from the alternate pressure of cold and of heat on the human body, the vicissitudes of the cold and hot fit of an ague coincide more with the movements of the sun and moon than they do in temperate and cold climates.

Some entities of an organized and living sort, when cold increases greatly in the atmosphere without, and penetrates in, and compresses, and expels the heat which entities previously harboured, and causes all the fluids they contained and circulated through them to experience a rapid and sudden combination, congelation and arrestation, thereby are made to cease being capable of assimilating food; and, when these entities are of an animated sort, also to cease being capable of harbouring sensation, thought, will and impulse to voluntary action, and fall into a state of corporeal and mental torpor; in which state they remain, while this preponderance of cold continues; and this is called a state of hibernation.

When from an internal cause, such as the obstructions opposed from within by the substances already cohering, the entrance of fresh substances from without is made to diminish, the influx of fresh heat from without is likewise made to decrease: as there is less heat coming in from, there is also less heat going out into the atmosphere, and less perspiration: the limbs feel colder.

But from mere weakness and want of power to retain even the substances already received within, whether in their fluid or solid state, at last arises a driving out of these and a perspiration, which neither caused nor accompanied by heat, feels clammy and cold, and is not only the internal effect but the external sign of that weakness; and generally is considered as a symptom of approaching death: when no further substances, and consequently no heat whatever, continue to be taken in, and the body remains for a time consigned to unqualified cold.

As the climate is naturally colder or hotter, it favours the combination of organized and living entities that require either more cold or more heat for their further increase and growth: but in hotter climates in which, together with substances, penetrates more of that heat which longer keeps these substances distended, unconsolidated and uncohering, there is room for a penetration of substances more copious and varied before they do cohere; and thus are produced bodies from their first commencement more large, luxuriant and rich, and which require supplies more abundant for their further continuation and increase.

In all temperatures alike, the substances that are within those elements called water and earth —themselves already less permeable to heat— condensed in entities organized and living, such as fuci, zoophytes, molluscæ, worms, fishes, amphibiæ and even certain quadrupeds, cause in their creations and growth less heat to flow in together with their inflowing fluids, and thus less heat to be driven out in the consolidation of these fluids, than flows in, and again is emitted by the entities like insects and birds made to live in thinner air.

In organic and living entities the heat that from without with fresh substances ever continues to penetrate inward, where again it is by the consolidations of these entities emitted, prevents not only the fresh cold which from without attempts to penetrate, from being so easily admitted as it is in bodies inorganic and lifeless, but even prevents fresh heat from without from penetrating so rapidly as it may in bodies inorganic and lifeless, and from gaining so speedily over cold that preponderance which, by destroying the balance between the two opposite elements, may, fromt heir being both in certain relative proportions beneficial, in other relative proportions, be rendered injurious.

Thus it is that in living bodies the cold from within offers a more effective shield against the excess of heat from without, and the heat from within offers a better ægis against the cold from without, than each does in entities still inorganic: and that as organic and living entities possess a vitality more intense and more active, they preserve, amidst the greatest changes and vicissitudes of the external temperature, an internal temperature more equable and calculated to resist the opposite extremes of the former.

CHAPTER IV.

How in bodies organic and living, from the superabundance of elements, substances and saps from without continuing to flow in, and forming cellular concretions, of these cellular concretions some are again converted into vascular concretions, which carry the saps flowing in them in greater quantities, more rapidly, to a further distance; and more favour their remixture with other elements, substances and saps, from the opposite side without coming in; and again cause of these new compounds the consolidation in new forms, cellular and vascular.

Many people think that vessels are one of the first conditions of vitality: because bodies not vital never have vessels; because bodies endowed with vitality, as that vitality becomes more active, have more vessels; and because where to cellular concretions are added vascular concretions, the former shrink in the background; the latter eclipse the former, and standing foremost, strike the eye so much more directly than these former ones.

This, however, is an erroneous opinion; firstly, because all organic and living entities arising out of inorganic and lifeless ones, and even inorganic and lifeless bodies themselves, already have a cellular and crystalline formation; secondly, because a vascular texture, though found in no inorganic entities, is not found in all organic entities, and a mere cellular and crystalline texture, spreading horizontally, and called in vegetables parenchyma, and in animals reticular texture, is found in many entities vegetable and animal of a simpler sort, such as tremellæ, nostochs, algæ and zoophytes, in which no vascular organization whatever can be found; thirdly, because where in organized entities a vascular system at all arises, it only arises after and on a prior cellular system; fourthly, because in many organized entities, in which, as in monocotyledinous plants, the cellular system is very extended, the vascular system still is very incipient and restricted; fifthly, because each vascular system, composed of peculiar substances, different from those of another prior vascular system, only arises after and out of the materials and upon the base of a peculiar earlier mere cellular system, also different from the former cellular system, and composed of the same substances that compose the vascular system which it immediately precedes and supports:—because each vessel only is composed of some prior concretion of cells and parietes, first only disposed in the shape of laminæ or follicles, before the saps continuing to run athwart these laminæ or follicles, by their increasing quantity and weight so begin to press down their centres as to make their margins from both sides curl up, reapproximate, and rejoin over where they first diverged, as to form cylinders or tubes, which permit the fluid driven in them to accumulate and pass on unimpeded in greater quantities more rapidly to a greater distance, before it again is arrested and consolidated—as we see in the first formation in seeds and ova of their vessels: sixthly, because a peculiar mass of cellular organs, disposed in follicles, thus serving as foundation, as material to every mass of vascular organs, also of this latter to the last rules the formation, disposition, direction, support and growth; seventhly, because where the fluids are from one side through these vessels driven forward, and are not at the other opposite side again poured out in air in the shape of evaporation or exhalation, but are at that other side by the resistance or opposite pressure of other elements and substances different from these first, coming from that other side, resisted, they have their molecules, before huddled together in a stream, again with these fresh substances arranged as before into a peculiar set of mere cellular and laminar solids, only different in size and shape from the former ones, before by fresh superabundance of the saps that formed these, a part of them is again moulded into new vessels; so that each new set of cellular concretions precedes and itself forms each new set of vascular concretions; as well as each new set of vascular concretions divides and separates each set of cellular concretions, from the next set of cellular concretions.

While thus all bodies merely inorganic and lifeless have the fluids they receive in an almost instantaneous period solidified in a mere cellular form, without afterwards having any of these cellular forms again, by the accumulation of new fluids, transformed into vessels, capable of carrying these fluids in greater abundance more rapidly athwart a greater number of cells to a further distance, certain bodies organized and living may, to cells disposed in certain cohering layers only extended straight forward, add certain of these layers moulded into tubes or cylinders called vessels, again on certain of the prior outstretched ones founded, from which these fluids again are poured forth to be either exhaled, or with fluids coming from the opposite sides moulded into new solids, first again cellular, and next also again vascular.

It is clear that the force which makes the laminæ before extended be depressed in the centre, and that which makes them curl up at the sides, must be, the former a gravitation centripetal, and the latter a gravitation centrifugal; and thus both be forces acting vertically, and in a sense contrary to that in which fluids are in vessels impelled latitudinally from one extremity to the other, and which thus appears to be electrical: a thing which is confirmed by electricity, as it is weaker or stronger, propelling fluids in the vessels with less or more rapidity.

When, however, from the form of the body the fluids are made to flow through the vessels in a horizontal direction or even in a vertical direction centripetal and downwards, and press not particularly on the parietes of these vessels, they leave them throughout their length smooth; and thus continue to flow through them to their furthest extremity uninterruptedly: but when by force of gravitation centrifugal they are made to flow through these vessels upwards in a centrifugal direction, their weight, pressing backwards on the parietes of the vessels, scoops these out at certain distances into bags or valvules, which by partly supporting these fluids against the pressure of that of centripetal gravitation, and preventing their being made by the same to fall backward, assist the force from underneath in carrying them forward.

When organized bodies are formed, between air and water, where the pressure from above on them is resisted by the counter pressure from underneath, the cells and vessels only extend between the two elements in a horizontal direction, and if at the extremity of the first or a former set of cells and vessels, spreading horizontally alike in all directions, a new set of elements and substances from within, by the resistance and counter pressure it meets, moulds a new set of cells and vessels, this new set of vessels only formed of a continuation of the same elements of which were composed the former vessels, can only assume the same nature and form; as we see in the confervæ floating on the glassy pool, which have not yet in their extension, wholly lateral and horizontal, any distinction between parts shooting upwards, and parts shooting downwards.

But it fares differently with organized entities, which first entirely formed in air, are made partly by the pressure of centripetal gravitation to elongate and grow downwards to the earth, and are next again by the centrifugal gravitation from that earth arising made to elongate and grow upwards in the atmosphere.

In these, after the first cellular concretion from within growing outwards has produced a first vascular concretion also going outward, the parts of that vascular concretion which face the sky, from which descend only elements lighter and finer, and those which face the earth, from which only rise elements more dense and aqueous, each only, with these new elements from without wholly different, produce, the one upwards and the other downwards, new cellular concretions wholly different, and which each again in its turn produces a vascular system wholly different from that produced by the other. Of these two systems, cellular and vascular, wholly different, in vegetables the one driven down, remains in its way to or in earth more huddled together, and takes the name of radicle or root, and the other pushed up, and finding in air more varied counter pressure, and yet more room to extend, becomes more flat and spread, and takes the name of plumule or leaf; but the new saps, by the mixture of new elements and substances from underneath rising formed in the cells of the radicle, are by the centrifugal gravitation from underneath pressing on and through the new vessels that spring from these cellular concretions below, carried upward and made to ascend, and the new saps by the mixture of new elements and substances from on high formed in the cells of the plumule, are by the centrifugal gravitation from on high, through the new vessels that arise from these cellular concretions above, carried downward and made to descend.

So much indeed are in vegetables, having one way distinct roots, descending downwards and seeking the earth, and having the other way distinct leaves, ascending upwards and seeking the air, these roots one way universally formed of the saps descending downward being made to mix with the aqueous fluids, which the centrifugal force drives up from the earth, and these leaves the other way universally formed of the saps ascending upward being made to mix with the aerial fluids, which the centripetal drives down from the atmosphere, that in some vegetables, like the bramble in England, and the banian tree in India, from the very extremity of their branches, nearest the sky, the parts that face the earth and the elements from that earth driven up, are still made to drop down roots to that earth; and that in some other vegetables, like the sallow and the poplar, from the very extremity of their roots deepest buried in the earth, the parts that face the heavens and the elements from the atmosphere driven down, are still made to shoot forth fresh buds and leaves into air.

And if the roots always have forms lumpish and huddled together, and the leaves on the contrary have forms regular, spread outward, and often complicated, this proceeds from the component molecules of roots only in their extension and solidification from that earth encountering a counterpressure lumpish and huddled, whereas the leaves in the air, in the extension and arrangement and solidification of their molecules meet from that air without with a counterpressure more elaborate, more finding room to extend and develope, and more adapted to the peculiar nature and form of the solid molecules over which that counterpressure is, from on high, exerted.

Before, however, I proceed further in my account of the fate that awaits in organized and living entities these two opposite fluids, the one composed chiefly of elements ascending from the earth, and the other chiefly of elements descending from the atmosphere, let me here stop an instant to discuss the words which I am obliged to use for the purpose of describing various modifications, in order thereby to facilitate their comprehension.

At the first steps in every science, and while on retrospect the differences of a later and more superficial sort by which entities are again distinguished, strike the sense and intellect more forcibly than do the earlier and more deep hidden similitudes concealed under these differences from which they themselves spring, and by which they are at their origin united, many things, in consequence of these differences, are distinguished by different appellations, which afterwards, and when we dive deeper in the subject, we find to be, from their earlier similitude and origin in a common source, entitled to a more generic common appellation; and then the names more specific which mark and are exclusively attached only to these differences, by fixing the mind more exclusively on them, and preventing us from attending so much as we ought to their more deep laid similitudes which precede them, prevent the progress of science, which all new words coined were at first intended to forward.

This defect is greatly felt in studying in different entities the attributes of symptoms of organization and life. We find that modifications that are fundamentally the same in entities merely vegetable and in entities of an animated description, are marked in each by appellations wholly different; and that thus we only are left to infer the resemblance which the similar appellation in both should itself have directly announced. We find that thus the multiplicity and diversity of signs for the same things prevents our rapid perception of that similarity which in those things really exists, and which all signs where it exists should express; and that instead of facilitating, these signs only render more difficult and more confused the comprehension of the things they are intended to mark.

Thus in common parlance we call entities that share in the attributes of organization and life, not first and generically by the name of those attributes they alike share in—not by the name of the attributes of organization and life, which renders them both alike different from entities destitute of organization and life, and which assimilates each fundamentally with the other—

but only by the distinct names of vegetables and of animals.

Thus again, both in vegetables and in animals, we call the solids more immediately, on being from a fluid state consolidated and crystallized, merely cellular; and when of these cellular concretions and laminæ a part is rolled up in tubes and cylinders, we give them the name of vessels, though their parietes still retain their fundamental cellular structure.

Thus in vegetables we call exclusively seeds, and in animals ova, the earliest distinct form, in which their component substances are collected in a single cohering body.

Thus we call in vegetables the earliest shape of that body by the name of cotyledon, and in animals by the different name of placenta.

Thus we call in vegetables exclusively parenchyma, and in animals exclusively rete mucosum, that concretion of solids merely cellular and laminar, which in both entities alike precedes and forms the foundation and first stage of every later and more partial vascular formation composed of the same substances.

Thus when the first and most fundamental saps that form the cotyledon or placenta are, by new mixtures from without, one half with saps from the earth rising upward, and the other half with saps from the sky descending downward, made to divide in two different sorts of saps, we call in vegetables those from on high descending, merely descending saps, and those from underneath ascending, merely ascending saps; whereas in animals, we call the first lymph, and the latter chyle.

Nay, when in animals of a later and more complex description, besides the aerial elements entering through the external pores, there are similar pores perforating internal cavities, these latter entirely lose their name of surface even internal, which they have a right to retain, and only according to their size, depth and number receive the different names of tracheæ, bronchiæ, or lungs, stomach and bowels.

I allow that of these different names, those that only mark a different stage of development in the same organs, may be necessary to express this difference; but those which only mark the same stage of development in different entities, are superfluous, and if not commented upon, as I said before, serve only to confuse instead of clearing up our ideas.

I shall, therefore, as far as custom will permit, preserve the remembrance of the original formation and of the resemblance arising from it, throughout all the later differences of substance in which that resemblance may be shown, in vegetables and in animals; and shall, by way of rendering more distinct and clear my denomination of the saps, different from each other, which are produced by the remixture of the first and most fundamental fluid on one side with new elements from on high, and on the other with new elements from underneath, call the one sort which from on high descends, the aerial, and the other which from underneath ascends, the aqueous sort, both in vegetables and in animals.

The point in organized and living entities at which of the fluids of the first and most fundamental sort, in the first instance throughout homogeneous, a part is made by their weight to descend, and after partly with new aqueous elements from the earth underneath forming new solids, cellular and vascular, is through these new solids again made to arise, and another part is made by the resistance to this weight and the counter-pressure thence produced to ascend, and after partly with new aerial elements from the air above forming opposite new solids, cellular and vascular, is through these new solids again made porate above or below, but resisted and prevented by a part of the fluid of the opposite sort, is again made to revert inward; and when it is there also resisted, is made to form into new opposite solids, similar to the former opposite solids, which, again driven beyond these, superstruct or substruct beyond them new additions to the former fabric, through dint of a see-saw, which continues till the vessels obstructed or overlaid by others refuse their office.

But in higher organic entities of the animal sort, in which to the elements that, when organized, only live and grow, are also superadded other elements that, when organized, feel and think, and display will and voluntary action, for want of room these same opposite fluids, aqueous and ascending, and aerial and descending, only continue to be directed to, and to increase and invigorate to the end the very same opposite forms, cellular and vascular, till at last they obstruct and cause them to decay and to die; which they consequently do in a more definite period.

But of this and other differences between mere vegetables and most of the higher animals, more hereafter.

I shall first here only make a few more remarks, which I think equally applicable to vegetables and to animals; and specify a few more attributes in which each still resembles the other.

CHAPTER V.

The same circumstances that, in productions of nature, produce peculiar generic wants, also produce in them the means of obviating these wants.

When we find that if of each planet only one side receives at a time from the sun the influxes of light and heat wanted for its support and benefit, we also find that this deficiency of simultaneous light and heat supplied all round, is compensated by the planet turning its different sides in quick succession to the sun; that if of our peculiar planet each different part naturally produces peculiar entities, vegetable and animal, different from that of another part and having different wants, it also is naturally provided with the peculiar means to obviate those peculiar wants; that each animal whose stomach and interior requires a peculiar species of food, also, as soon as he begins to want the same, begins to be provided with all the peculiar external organs of pursuit, prehension, attack, and defence best calculated to cater for the wants of that peculiar stomach and inside; that while vegetables, and even those animals that need not for providing their means of subsistence, organs of locomotion, possess none such, entities on the contrary requiring them each possess the exact sort suited to their wants; that the earth-worm, destined to live in the narrow and tortuous bowels of the solid globe, and to whom a body dense and rigid would be an incumbrance,—would only impede his underground progress,—has a frame slender, elongated, smooth, elastic, and flexible, able to wriggle itself athwart the narrowest and crookedest interstices and sinuosities of the element across which lies its path, while the aerial insect, enabled to perform its various movements through a thin and yielding atmosphere, has his light body by long and spreading wings easily buoyed up in air; that the animal first produced in water and first only possessed of the narrow lungs and short limbs required to support him in water, when afterwards he is lifted up in air, also puts forth the wider lungs and longer limbs requisite to support him in air, and from a worm turns to a fly; that the fish, destined for the aqueous element, has in the internal air bladder and in the external configuration lumpish but sleek and provided with short fins, all that he wants for his varied movements in the denser medium that surrounds him, while the bird, destined for a more aerial abode, possesses the internal expanded chest, and the external extended pinions, calculated to cleave the finer fluid of the atmosphere; that every animal has the peculiar covering of scales, of feathers or of fur, the peculiar weapons of attack and of defence, the teeth and claws best adapted to the peculiar exigencies of his abode and situation; that in living and breathing entities the ascending vessels which want valvules to support the fluid rising in them have such valves, while the descending ones, which want none such, have none; that in all animals what is good for the stomach and body is also grateful to the sense, and *vice versâ;* when we find all this, I say, we are apt to consider, between the wants felt on one hand, and the means given on the other hand, in order to supply these wants, the peculiar coincidence as the immediate effect only of certain after-thoughts of Providence, which unable, as it were, to avoid producing the wants, has, after producing them, bethought itself of the means of obviating their effect; in the same way as man does, when, having discovered in his handy work a peculiar imperfection, not foreseen, he seeks and devises some remedy for the same not previously thought of; and we extol the wisdom and goodness of God for so doing, as if, even according to human modes of viewing things, it would not have been wiser and better not to produce the peculiar wants at all, which require such remedies, than to have, with the peculiar wants, also provided the peculiar remedies by which they may be supplied.

This, however, seems but a confined mode of contemplating nature, and of lauding nature's

Author. Already in many cases in which at first sight we thought that we only perceived for the wants produced in different entities such *ex post facto* remedies, we have on more mature investigation discovered that nature, instead of having first produced the imperfection or want, and afterwards having, by a later and separate act of thought and volition, produced a remedy or a cure, not arising spontaneously out of the same cause as the imperfection or want itself, but only more lately applied to the cure or supply thereof, the very same circumstance, prior both to the evil and to the remedy, that caused the one, itself also laid the foundation of the other; that the evil and its cure had the self-same prior source.

Thus we have already found that the very same modifications of the laws of gravitation which caused round more primary globes, throughout resplendent with light, the formation of secondary globes more opaque, and which could only from the former derive the light which their surface wanted, also caused these secondary globes to revolve round these primary ones, so as to make every part of their surface in turns successively receive this light, required from the more primary globes.

We have already found that each entity, vegetable and animal, spontaneously formed on this globe, is here, wherever it naturally and spontaneously arises, made to find all the elements it wants for its further support and increase, precisely because it first naturally and spontaneously arises only out of the very elements, already in their unappropriated state peculiar to that soil and climate; and because organic and living entities only want for their further and later support and growth, elements of the very same sort with those out of which they first were formed.

We have already found that if, in vegetables and animals, at peculiar periods, and when for pursuing, prehending, and appropriating to themselves the substances they want for their further support, they also want new external organs and limbs of a peculiar sort, which before, and while they wanted not any such, they received not, this new accession of means of providing for their new wants only then takes place, because at that period the nature of the new elements they begin to take in more copiously and to want more constantly, themselves also from within causes an ebullition, an expansion outward more forcible, producing those very limbs more prominent, which are necessary to take in those new external elements more readily and copiously.

We have already found that in the herbiverous ox that same diffusion and laxity of component parts, which internally, and for his further support and increase, only wants the juices less concentrated of herbs with which he fills his wider paunch, also only causes that same more extended carcass externally to put forth from its sides those extremities and limbs less developed, less capable of quick pursuit and prehension, and only armed with an obtuse hoof, only capable of supporting him on the level pasture; and only from its anterior orifice—its face—to sprout forth those teeth, likewise more blunt, only fit to bruise the tender herbage; and that in the carnivorous tiger, on the contrary, which internally and for his further sustenance and growth wants the juices more concentrated, only afforded by prior animals, to fill his more contracted stomach, that same increased vigour alone also causes that same body less bulky and more condensed, to put forth those limbs more powerfully knit, ending in claws more extended, more ramifying, and more sharp, with which to pursue and prehend, and in those teeth more piercing, with which to tear and to assist him in swallowing his prey.

We have already found that while in vessels through which the saps descended, as there was no necessity for the saps descending being supported, there was no provision made for their support, in vessels through which the saps were to ascend, and where a provision for their support was necessary, their very weight during the ascent scooped out in their parietes the valvules necessary for support during that ascent; we have already seen that if beasts in certain of their organs require a peculiar extension to make them conducive to the peculiar purposes for which they were intended, these purposes themselves, first only wanted in a less degree, gradually also, by the elements they serve to take in, gives them that further extension required; that if man so constituted as to want food more various than brutes, also receives organs more various than brutes for its prehension, its mixing, its maturation, its mastication, its digestion than brutes, this is because in man, from the very first composed of elements more various than brutes, the forms in which these elements are united and made to develope, afterwards produce both for their support those wants, and for the supplying those wants those means more various and complicated exhibited by brutes; that if a peculiar part or organ suffers some extraordinary injury or destruction, the supply of fluids that before was employed in its support, now pent up, accumulates unemployed till it is collected in sufficient quantities to supply the loss, and to supply an entire new part or limb of the same sort with the one that has been lost. In short, we have already discovered so many instances in which peculiar wants and peculiar provisions to supply those wants, both arose out of the same prior common source—in which the same prior circumstance produced both the want of a particular object and the supply of that object —that we have reason to suppose, in the instances in which we do not yet see this harmony and coincidence between the want and the supply—in which the want only proceeds from one circumstance, and the supply appears only to proceed from another later different circumstance, independent of and distinct from the former,—this circumstance only arises from our not yet being able to look far enough back, and to take in a scope of objects sufficiently extended, to arrive at the common origin of the want and of the supply: we are founded to believe that if we could only take our survey of surrounding objects from a globe sufficiently elevated, central and early, we should find a common origin and source for all the distinct natural wants we experience on this more late and partial globe, and for all the distinct and different natural means we find to obviate these wants.

In the present system of the universe, and particularly on the present globe, extensions and movements from within outwards, unfoldings and developments, are not always made to go on in uninterrupted progression, but are by Providence, in many times and places, through the division of matter in smaller portions, only made to alternate with resistances and checks, returns and retrogradations, envelopements and unfoldings. Through that division of matter in lesser portions, after from each separate point part of that matter has been made to advance to a certain distance outwards, it is again by meeting another portion of that matter, from a different point advancing outward in a different direction, checked, repelled, made to revert inward, to return nearer the point whence it first set out, and there again to meet another portion of matter, in the succession of time and the extension of space developed after it, by which it is also again on that side, in its retrograde direction, arrested; so that both in time and in space its advancement may be said to resemble a spiral, which, at certain periods in its progress returns to points near those where it first originated, than those which in the intermediate periods it had reached.

As an example of this circumstance—a leaf is first formed straight in its vessel. It is next made, as it extends, by the resistance of that vessel and the want of room in it, to infold; until it again is driven out in air, and there left to unfold a second time to a wider extent: the same happens to an animal in the womb.

Even men who think and talk more philosophically than the vulgar herd of mankind, think and talk as if in nature of extensions and developments, forces and faculties, the progression, once begun, went on without further check or hindrance. In doing so, they overlook that in this universe, and particularly on this narrow further times, from more distant points of space, bring back things nearer to the points of space whence they first started: that in time and in space, by the laws and modifications of gravitation centripetal and centrifugal, and of electricity called positive and negative, by the conditions of alternate cold and heat, and by those of every other sort of force and substance, instead of each portion of each of these different later attributes that arise out of the earlier ones having an indefinite extension, and progress, and movement forward, and growth, each is again, at a certain distance from where it set out, exposed from an opposite quarter to meet with a resistance, check and counterpressure, which again makes it recoil, retrograde, revert backward in the direction in which it had advanced; move, act, and impel in a sense opposite to that in which it had moved, acted, impelled at its first departure, and even at that later period and in that further space, within the former unfoldings and developments, again find later unfoldings and developments, which it again arrests, checks, or by whose superior force, and extension, and swell, and pressure it is itself made to burst, break, and dissolve—that, in other words, all things have their pulses, their alternate extensions and contractions, advancements and recedings, pressures and counterpressures, floods and ebbs, comings in and goings out.

Man forgets that already long even before distinct worlds had begun to exist, of the very earliest forces that arose out of the mere combination of time and space, and that in their turn again became the parents of every later modification of force and of substance, mineral, vegetable, animal, sensitive, and intellectual—of the force of gravitation in short, which pervades the whole of the known universe—certain portions were in their progress again by certain other portions of that same force of gravitation so checked, arrested, repelled, and made to recoil, as to revert backward, and, from centripetal and advancing inward, to be made to turn round, to circulate, and again to become centrifugal and advancing outward.

He forgets that when, out of portions of gravitation centripetal and centrifugal, from opposite sides meeting and combining, again arose that force called electricity, that electricity only when from opposite sides converging, in its convergence inward produced the pressure of cold and combination; and that when its opposite rays by again meeting were again made to recoil, to diverge outward, and to dilate what they had before compressed, they again by their expanding force produced heat, and decombination of what the former electricity had combined.

That it was only the combination, the arrestation of the force of gravitation and of prior electricity, by later electricity from opposite sides compressing produced, that out of mere forces produced what are called substances.

That only by forces and substances first radiating, which from opposite sides were made to converge, till they checked each other and combined together, were first formed the earliest and largest and most centrical and primitive globes; and that in part from rays of force and substance from these globes again made to recoil, and to advance in a retrograde direction, till they were again at a distance from the former globes by the later rays converging to the same, arrested, resisted, checked, and made with these to unite in a more stationary aggregate, were produced round the more primitive globes other globes later and lesser.

That only out of the opposite pressures of these primary globes on the secondary ones, and counterpressures of the secondary on the primary ones, arose those revolutions which the secondary globes describe round the primary globes, and which at certain periods make them return to the points whence at prior periods they started.

That on this, and probably on many other second or third rate globes, after substances first radiant are by compression and cold converted into gases, liquids and solids, these solids are again by distension and heat, reconverted into liquids, gases and radiance.

That on this likewise, and probably on many other second and third rate globes the elements of bodies are divided in reigns merely mineral, or also vegetable, or moreover likewise animal, distinct and separate from each other; and each of these reigns are again divided in genera and species equally distinct and separate from each other, each of which species singly and individually, after it has from its most incipient points and limits extended and grown to a certain degree, is by the opposite extension, resistance and counterpressure of certain of the other species, prevented from extending further.

That the same which happens to each genus extrinsically and relative to other genera, happens to different portions simultaneous and successive of each individual genus intrinsically. That of the different portions simultaneous and successive of which its whole is composed, each part, after a certain degree of extension and growth, is by the extension, growth, resistance and counterpressure of some portion of another genus, or of some other individual or portion of the very same genus again counteracted and repressed.

That of each individual each separate component portion is in the same way after a certain degree of extension and growth, even by some other neighbouring part of the very same individual checked and prevented from extending further, nay made in later time to decay, die and dissolve; that certain parts exhaust other prior parts, though the medium of which they were first formed and supported, and next, themselves, for want of the further support of these former parts, die and dissolve.

That in organized matter and bodies only pressures and counterpressures, advancements and retrogradations from opposite points, ever successively more numerous and more diversified, produce all the divisions and differences of a later and more minute description, first in systems vital, aqueous and aerial, chyliferous or lymphatic; next, and arising out of the reunion of these, in later systems sanguineous, veinous and arterial; and next again, in systems sensitive and mental—in systems of thought inward, and of voluntary reaction outward—which arise out of and are superstructed on earlier and more general divisions and differences.

That in this organized and living world, after the pressure from within to opposite points without less or more numerous has made parts vital, sensitive, intellectual and reactive each individually begin and extend to a certain degree, the further counterpressure of later parts from without on them again makes their own later and more external parts turn back, fold over their earlier and more incipient parts, and enfold and envelope these, before by their swelling they burst and break and dissolve the barriers that checked them, and again a second time expand more amply and fully.

That thus in vegetables, the different systems of cotyledons, of roots, of leaves, of parts aqueous and parts aerial, after having developed to a certain degree, are each again by the later pressure they meet with from without, made to double down, and to fold themselves in, till by swelling and pressing against the integuments later formed round them, they liberate themselves from these, and again develope and expand on a larger scale.

That in animals in which the case is the same as in vegetables with the mere vital parts, the process still is repeated more minutely with the additional parts sensitive, intellectual and others, not possessed by mere vegetables: that these too after certain evolutions outward are again, by certain barriers from without placed around them, made to form further involutions, till such way find room for and dispose of, and which even within themselves still remain distinct and separate from them, form the nucleus and lay the foundation of other similar evolutions and involutions, developments and envelopments in others first formed within their parents, which in their progress are, for want of room, sooner or later made to detach themselves from these parents, and to begin a separate existence.

That even in the vegetables and animals, composed of parts different from each other more numerous, more varied and more complex, in the incipient stage of their individual progress, and long before they have reached its utmost point, certain parts, such as those aqueous and those aerial, each singly take so much room, that the further development of the other opposite parts cannot continue fully to go on in the same individual: that whichever begins by having a preponderance crushes the other, and only singly continues its further development, and that thus of the two different sexes, composed by the predominance, the one of the parts aerial, and the other of the parts aqueous, the completion can only take place in two distinct individuals, of which the conjunction is again necessary in order to bring together all the elements that are necessary for the production of a third individual, in its earlier and more fundamental parts possessing all the requisites of the species, and all the attributes that shall make it resemble either parent.

That in each individual the pressure inward and the consequent later extension outward, far from ever increasing, are each after a time again so resisted and counteracted, the one from within and the other from without, as to turn to stationariness, decay, death and dissolution; so that some entities will go down hill and disappear, while others appear and rise in their stead.—

And finally forgets that on this globe all the difference between one reign, genus, species, individual and part of an individual, and another, only consists, as I said at first, in the extent to which its development is carried, before by some counterpressure it is again made to shrink, to decay and to disappear.

CHAPTER VI.

Causes of generic forms and individual deformities.

As of each different substance, each different side already in its radiant state, to forces dividing and compressing it, offers a different degree of resistance, when by forces of electricity of a combining sort a substance first undivided is divided and compressed in lesser molecules called gaseous, of each substance each component molecule, as we have seen, offers a peculiar size and shape, always similar in all the molecules of the same sort of substance, and always dissimilar in molecules of different sorts of substance.

And when of these molecules of a single sort of substance a certain number are made to fit on to each other, and to cohere together in a large body, in the way they are best calculated to fit on to each other and to cohere together, this larger body must likewise, from the peculiar sizes and shape of its lesser component parts, and from the direction in which these lesser parts are naturally made to cohere, assume a shape always the same in bodies composed of the same, and always different in bodies composed of dissimilar substances.

Nay, when molecules of a certain substance are naturally mixed with molecules of a different sort of substance, in the relative number, proportion, and situation in which they naturally fit on easiest to each other, and cohere best together, the sort first and most generally predominating, must among the different other sorts later presenting themselves, also cause those sorts in preference to penetrate withinside the former and to cohere with them, which can best in peculiar relative proportions and dispositions penetrate within and cohere with these. If different sorts present themselves at the same time, an election must be made between them; the fittest to cohere with the former must be chosen, and that in the fittest quantity; and thus substances must always unite with only definite new substances, and with these new ones only in definite proportions: where the first leading substance is similar, all the remaining substances added to it must be, regularly, similar; and where the first leading substances are different, all the remaining substances added must also be different.

This already takes place in bodies, in which all the substances cohering are seen to cohere at once, where there is not elasticity enough to let later cohesions succeed the first, and which, consequently, to the last, remain inorganic and lifeless; and it equally takes place in bodies whose greater elasticity allows later cohesions to succeed earlier ones, and which thus become organic and living.

It already takes place in organic bodies whose extension, being latitudinal, on all sides remains similar; and it likewise takes place in those whose extension being perpendicular, and, partly upwards to the sky, and partly downward to the earth, by making them face two opposite elements, from above makes them take in such elements as are different from those they take in from underneath; and thus, in one sense and at one end, makes them add to their former substances new substances different from those new substances which they add to their former substances in the other sense and at the other end.

Nay, if two individuals who in time become of sexes different from each other are again later required to unite in order to bring together a sufficiency of all the elements of which they themselves were first composed, and of which other entities like them must be first composed, these two individuals must each have the sort wanting in the other, in order with that other to compose the full complement of the elements required to begin a new individual, composed of the same elements of which each of the parents was first composed, before one sort of element gained such a preponderance as to exclude the other sort.

Though, to be sure, the preponderance of certain of the peculiar elements belonging alike to both parents, which exists in one of the parents, may be so transmitted to the offspring, that that offspring may in forms, features, movements and manners, and even in turn of intellect and disposition, have an individual likeness greater to one parent than to the other—even where that offspring has never seen that peculiar parent, and cannot be suspected of having derived this greater similarity to the same from imitation.

Thus it is that already in an acorn which developes in an oak, we not only find the reason of all the generic forms different from those of the acorn, that only proceed from it in that same individual oak, but the reason of all the successive generic forms that proceed from it in all later oaks that may again in their turn from that first oak descend to the end of time.

And that already in an ovum which developes in a tiger, we not only find the reason of all the generic forms different from those of the mere egg that proceed from it in that same individual tiger, but that proceed from it in all the later tigers that may arise from the first of the species, unto the utmost confines of the globe: even long after the first vegetable or animal of that species, which determined these later forms, itself exists no longer.

When in an object of nature—in an acacia leaf, in a narcissus flower, in the insects called asterias and papilios, in the brute and in the human being, we see the most perfect symmetry of forms and colours; when of each of these forms and colours of which we behold a specimen on one side, we behold the exact counterpart on the other side, we cannot help at first attributing this exact symmetry, so pleasing to the eye, to a refinement of art. We imagine nature at work in her study, artfully combining the forms and hues that by their symmetry and their contrast will most gratify the sight.

We are indeed so much accustomed in the works of nature to this symmetry, that in those fewer objects, whose forms and movements have it not—as certain crystals which are rhomboids, certain plants, whose leaves, like those of the begonia, have their lobes awry; certain animals, like the oyster, whose features are crooked, or like the crab, whose gait is sideways, and even like man, whose liver is pushed on one side, and whose heart lies unbalanced on the other, it is all we can do not to regard these peculiarities, generic, and inherent in the whole species as they are, as being nevertheless defects and deformities.

Yet in natural bodies both their symmetry and their want of symmetry, when generic and pertaining to the whole species, have in nature their undeviating causes, which must precede the existence and the taste of man.

When the first forms of a solid and cohering sort which in nature arise, have other forms of a later sort added to them, whether the stream of these later substances penetrates withinside the mass of the former solids, and divides this in two halves separate from each other, one to the right and the other to the left of this central current, or whether in its fluid state this current is itself again by these former consolidations, driven outward to the right and left of them, and made round these first to divide and consolidate into two distinct aggregates, enveloping the former mass, the result equally must be, without any study or design such as man might display, in the different forms simultaneous and successive that arise from the process, some peculiar symmetry simultaneous or successive.

This symmetry we see to exist in most minerals, vegetables and animals, in their substances, forms, hues, and consequently movements and actions, all disposed to the right and the left of a central line: and thus it is that in individuals composed of many parts simultaneous and successive, that symmetry which we regard as one of the last efforts of art, is already one of the first attributes of nature.

But, as we have observed, not symmetry, but a certain peculiar definite want of symmetry, is in some entities mineral, vegetable and animal, a generic and undeviating attribute: some have a certain generic obliquity and twist.

Where this is the case, the very first and leading molecules already in their forms have that twist, which they transmit to all later and more external ones superstructed upon them. It is the twist which we find in the crystals called rhomboids, in the vegetables of the begonia tribe, and in the animals called pleuronectes. It is the peculiar twist in their forms which makes spiders and crabs creep sideways.

In certain organized entities of a higher sort, and in which are formed a greater number of parts and organs than the later integuments formed round them leave room to remain in the symmetric position relative to each other in which they were first formed, the symmetric disposition itself may gradually be defeated by the pressure from without which causes these parts to be huddled together, in the way which the relative order of their formation, and the relative fitting of their forms to each other may determine, especially where the internal contents grow faster in size than the external capacity of the envelopes that contain them: and thus it is that in higher brutes and in human beings the liver is shoved to the right by the heart, and the heart shoved to the left by the liver.

Besides this formation and this disposition of parts simultaneous and successive, more regular and generic, which takes place when each sort of molecules, earlier made to cohere with another sort, has, among the later ones which present themselves in preponderating quantities from different quarters, the choice which soonest and easiest to admit and to cohere with, there may be cases where the accidental or wilful proximity and preponderance of some other sort of molecule, somewhat less fitting than the former, or in proportions somewhat less suitable than the former, is yet fitting and suitable enough to be, in the absence of the former, attracted and made with the substances already solidified to combine: and thus arise new forms not yet beheld, less generic, less regular than those thus far seen: as appears in entities made to display the peculiar forms of some disease, or the forms of two different entities mixed in a hybrid.

But this forced conjunction is so rare and so difficult to produce, that it only becomes in its turn prolific, and only again produces an offspring, where the parts united are very congenial to each other; and that even then, where to that offspring has been left an option in its further conjunctions, these will insensibly make its own later offspring again return to the forms which first preponderated; and that where the conjunction takes place between parts which are less congenial to each other, it produces no fruit, no offspring whatever, and remains wholly sterile.

CHAPTER VII.

Many bodies organized and living of a vegetable sort, to their first and most fundamental central parts merely cotyledinous, add other parts more extreme, again different from the first and from each other: partly facing the earth and called roots, and partly facing the air and called leaves; on which are again founded other parts still later.

I HAVE in my first volume shown that if, to the elements that still leave bodies too little elastic to make them become organized and living, is only added a sufficiency of carbon, they are rendered elastic enough to acquire the organization and life of vegetables; and that if to these elements is again added a sufficiency of nitrogen, they again are rendered even elastic enough to acquire the additional organization and life of animals: but that these new elements, again added to those already possessed by mere minerals, render in these latter bodies the whole quantity of elements, only wanted to form mere minerals, again proportionably less.

I have next launched out into some episodical observations relative to certain attributes, which mere vegetables and animals possessed in common.

I shall now again resume my account of the progressive developments of the first and simplest sort of organized and living entities—of vegetables,—before I pass over to that of the more complex sort—of animals.

We have already seen that in those vegetables beyond the very first and simplest sort, which only have a single species of mere cotyledinous formation, expansion and growth, and which to the very last may be said in that expansion and growth to remain merely cotyledinous—among which sort of vegetables, perhaps, belong those early and minute bodies, allied to the byssi, tremellæ and other cryptogamous plants, which redden the polar snows, give a green or gray or yellow tinge to the water, or to the solid mineral bodies on which they expand, and generally, only lying on a flat surface between heaven and earth, only expand latitudinally—are those that, situated between heaven and earth, have a longitudinal expansion both upwards and downwards; and from their first parts cellular and vascular, composed of fluids descending from the air and of fluids ascending from the earth, which meet, mix and combine in these solids cellular and vascular, again pour forth a part, of which part one half, by gravitation centrifugal from underneath determined upwards, is by gravitation centrifugal from on high, with new elements descending from the atmosphere converted into new saps and solids, cellular and vascular, of a description more aerial than the first fluids and solids, called leaves, which again send the superfluous saps flowing in them downwards, and of which the other half, by gravitation centripetal determined downwards, is again by gravitation centrifugal from underneath, with new elements ascending from the earth converted into new saps and solids cellular and vascular of a sort more aqueous than the first, called roots, which again send the superfluous saps flowing in them upwards:—and have seen that, when from the first and former leaves, the superfluous saps are again by gravitation centripetal made to descend, and when from the first and former roots, the superfluous saps are again by gravitation centrifugal made to ascend, those portions of those two opposite saps which cannot each advance in their opposite directions, till they each find an outlet and evaporate, the one in air and the other in earth, but are made to meet, check, and arrest each other, are each again, by their stoppage from before made to receive from behind a greater pressure, the one from underneath and the other from above, are each again made on the spot to receive fresh consolidation, the one in fresh leaves and the other in fresh roots; which fresh leaves and roots, first formed withinside and between

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former leaves and former roots, are again driven; the leaves upward and the roots downward, till they again find an outlet, generally beyond the former ones; and there, by further elements taken in from within and from without, complete their own expansion, and to the former leaves adding new leaves, and to the former roots adding new roots, thereby increase the multiplicity of opposite organs of the plant, and the size of its whole.

Seeing that in many plants, in which to leaves and roots are added stems, branches and twigs, at the end of the season, when the more tender and delicate leaves drop off and die, these more solid stays which support these leaves continue to live and grow, and to remain uninjured by that cold of winter to which the former yield and give way, one would at first sight suppose that it was these stems and branches which supported the leaves.

Yet the contrary is the case. Leaves and roots rise and descend before the stems, branches and twigs are born: stems, branches and twigs are only the later sturdier offspring and development of these tender leaves: since, firstly, many plants that already have leaves and roots have not yet any stems and branches,—witness the cactus; since, secondly, where stems and branches exist, they are only the further elongations of the vessels that proceed from the leaves and roots, and which, elongating in opposite directions in the intermediate space between the one and other, there cross each other and form together the fasciculus of vessels ascending and descending that composes these stems and branches; since, thirdly, these vessels, elongating in their opposite directions with unequal speed and to an unequal length, often only ultimately arrive in the same time at the same goal, by means of one of the two sorts being by the other, which stretches out more slowly, and only stretches out in a straight line, forced to elongate in a spiral; and since, finally, the vessels from above, where entering the fasciculus formed by the vessels from underneath, generally are by the resistance of these latter made to do so with such difficulty as there to cause around them an enlargement, and themselves to experience a strangulation, which, when the autumn torpifies the saps, make the place of this forcible entrance that where the elongation of the leaves loses its cohesion with the twigs, snaps asunder, and, causing these leaves to detach themselves from the twigs, branches, or stem, causes them to drop to the ground.

CHAPTER VIII.

Vegetables monocotyledinous and vegetables dicotyledinous.

In plants in which, as in grasses, graminæ, and in the palm tribe, the cotyledons are only single, they first not only at the lower extremity near the earth shoot forth a single root, but at the upper end next the sky send forth a single plumule or leaf, of which the aerial descending fluids, when arrested by the aqueous ascending fluids of that root, are only made to form new leaves composed singly and not in pairs: and, when from the aerial descending fluids of former leaves are formed these new leaves, also each single, which, arising from a single base continue to form a single bunch or tuft, this single bunch, however much it may by successive increments rise in height, does not much increase in number of leaves, or in general size.

But there are plants of which the first cotyledinous aggregate becomes by a pressure centrifugal which penetrates it so divided as to form two separate cotyledons or halves: and while even in this aggregate the vessels elongating downwards still are, by the pressure of gravitation converging, united in a single root, the vessels driven upwards are, by resistance of the same gravitation, made to split in two separate plumules, or in a pair of plumules or leaves: and when of the descending fluids of former pairs of plumules or leaves are formed new leaves, which again are driven upwards, these new leaves are, from the same cause with the former ones, always rendered double, and are at each remove from the former ones and from their own first origin made to spread farther and to form bunches more numerous, and more extending the size and diameter of the plant.

And while in the monocotyledinous plants the single fasciculus of vessels, descending from this single bunch of leaves, forces its way athwart the inside of the former vessels of the stem, and by the difficulty it finds in doing so, does not sensibly increase the number of vessels in that stem, nor its general diameter, in the decotyledinous plants on the contrary the numerous fasciculi of vessels descending from these numerous separate bunches of leaves, shape their course around the outside of the former vessels of the separate twigs, branches and stem; and form round the prior rings of vessels of which the branches and stem were composed, new distinct later circular rings, of which the outer ones are called bark, and enjoying room enough, distend at will, and materially increase the thickness of that stem itself.

The elongation of the vessels of the leaves downward, which with the elongation of the vessels of the roots upward form the stem and branches, are first disposed in the shape of hollow tubes or cylinders; and, when these vessels have not room for their exsudations externally, vent their superfluous fluids in insudations internally, which crystallize under the name of medulla or pith: and sometimes, when the accumulation of rings of later vessels outside over the earlier ones within becomes great, these later vessels, by pressing the former close together, destroy the hollow inside, and render the interior quite solid. The medulla or pith is then probably made by pressure from within to form horizontal vessels or tracheæ outward, and through these tracheæ to be forced out, without its deperdition being a loss to the plant.

While in monocotyledinous plants the stream of life, internally concentrated in a single fasciculus of vessels, terminates in a single bud, and when that bud is destroyed leaves no other buds to keep up that life and to replace it, in dicotyledinous plants, on the contrary, this life, having its stream divided between numberless branches, which each lead to and from as many distinct smaller buds, may still, when in some it fails, continue to flourish in others: nay, when the inner rings of saps ascending and descending totally rot and decay, be replaced by other rings which have been woven round them, and which again weave round these other rings still wider and more external.

Even round an old and cankered plant new healthy buds engrafted on it may weave a tissue, first of vessels descending and next of vessels ascending, which, themselves terminating in other new healthy buds, will renovate and strengthen the vegetable.

Both from the vegetables that send their new vessels from on high downwards withinside the former ones, and from those that send their new vessels from on high downwards withoutside and around the former ones, when there are a great number, some will only find room to suffer the new leaves they form to arise outside the fasciculus of the former creations, and there to constitute what are called suckers, which, when divided from the original stem, may form a new separate individual plant.

In plants, especially dicotyledinous, the fluids contained in the vessels ascending and descending which meet, often arrest and press upon each other so as together form cellular nuclei called glands, and from these glands to be forced out and to form vessels, in a direction intermediate between the opposite vertical directions of the former vessels, namely, in a direction horizontal; by which the fluids collected in them are thus again poured out as through gutters; and which are called tracheæ.

CHAPTER IX.

All bodies organic and living, vegetable and animal, through the pores and interstices that separate their solid parts, of the silica that floats in the atmosphere, take in a certain portion, which they again, mixed with other substances, exsude, and which outside these pores collapses and consolidates in an epidermis, through the perforations in which further elements from without can only be driven in regularly in such moderate quantities as to contribute to support, feed and renovate, without injuring, the intervening solids.

We have already seen that among the substances first radiant, next gaseous, which from general space around are driven to our atmosphere and globe, there is one called silica, which on this earth is found by itself, in a mere mineral state, condensed and consolidated in great quantities and masses.

Of this silica, of which already in the very atmosphere water and ice imbibe a great deal, a great quantity is on earth by organic bodies vegetable and animal absorbed, and in the process of their circulation again driven on, till from their different parts exhaled, it collapses and solidifies over these parts, and becomes to them and to the whole body a solid integument called epidermis, which, only through the pores, naturally by constant influx and efflux between the solids of that very epidermis preserved, letting in and out the other substances in such quantities as may support and benefit the solids underneath, serves these solids as an ægis and barrier against such an irruption of substances from without inwards, and such a deperdition of them from within outwards, as might prove injurious to that body,—a circumstance we see exemplified in entities around us, when by tearing off this epidermis we leave them more liable to external injury; and which we feel in ourselves when, by scratching off our own cuticle, we leave the dermis underneath, before by moderate influx of elements from without affected agreeably, even by that moderate irruption of these same elements affected painfully.

As the friction and pressure on the parts protected by an epidermis becomes greater, it enables those parts, by resisting the efflux of this silica more, and forcing a greater quantity of it to consolidate round them, better to resist that friction and pressure; as we see in the soles of [illegible] and in the gizzards of birds.

[illegible] become large and strong, [illegible] epidermis to protect [illegible] This external epidermis [illegible] nails [illegible].

[illegible] vegetable and animal, [illegible] through the pores of the body, [illegible] of the epidermis, again are [illegible] together with other forces and [illegible] streams of electricity. These streams, [illegible] outside the [illegible] of the epidermis, in their [illegible] prolong [illegible] into long tubes or cylinders, called, according to their substance and form, down, [illegible] feathers or [illegible] in general become stronger at those [illegible] extremities of the plant where the [illegible] as they do in young leaves [illegible] in insects at their articulations, [illegible] in their whiskers, in cats along their [illegible] and down their tail, and in human beings [illegible] the hair round the prominent parts of their [illegible] Sometimes, and in peculiar states of the atmosphere, the general evaporation of electricity from the body being stopped, that evaporation appears at the extremity of these hairs increased in visible sparks.

Not only in vegetables but even in animals, those parts which grow to such a size and consistency as no longer to want the protection of a delicate epidermis, this epidermis begins to crack, to peel off and to disappear. This we perceive not only on the stem of such trees as birch, but on the hide of such pachydermata as the elephant and the rhinoceros.

CHAPTER X.

Some vegetables by degrees to their more primary and essential parts cellular and vascular, ascending, descending, and transverse, and to the epidermis in which these are enveloped, add other ekings out, within, called wood, and without, called bark.

In many of the vegetables in which the roots and leaves elongate in vessels forming between them those neckings called stems or stalks, branches and twigs, these neckings remain so flexible that, at their rising above the ground underneath, the pressure from the air above weighs them down, and makes them, like the ivy and the woodbine, creep along the surface of the ground, unless they are by some more resisting solid body buoyed up, and assisted in their further ascent. In other vegetables, no doubt more porous, the expanding leaves inhale from air a sufficiency of that aerial element called carbon, to make their vessels descending exsude the same in the shape of a sap called alburnum, which in the stem, branches and twigs crystallizes round the vessels in the form of a fibre, elastic and shining, of which the collective mass is called wood, and which, to the parts round which it solidifies, imparts rigidity enough to support these in a centrifugal direction without any other assistance.

Every season which gives a plant a new accession of leaves, and from these leaves a new ring or sheath of vessels descending to the roots, also through the carbon or alburnum exsuding from these new vessels, weaves round the former layers of wood a new layer, which only seems to reach to the surface of the ground, and there to be stopped by the resistance of the earth from further descent: nor does indeed wood seem required lower down, as the roots, steadied by the solid earth around them, would only by the accompaniment of a surrounding sheath of wood lose that flexibility which they require to penetrate the interstices of this earth.

By degrees the later and more external rings or tubes of wood, thus woven round the earlier and more internal ones, by their compression, cause in these former rings the saps no longer to ascend or descend; when, deprived of their vital fluid and energy these former rings lapse into that state of inertness and siccity in which they become what is called heartwood, but also, for want of power from within to resist undue influxes from without, become more liable to be by these influxes injured and dissolved, even while the later and more external layers, still alive, remain capable of greater resistance and of increase. These latter rings are then, by way of distinction from the former, called bark.

In vegetables in which, as in aloes and in yuccas, the leaves last as long as the plant, or at least have no regular period of decay, the distinction of heartwood and of bark is not discernible: but in those in which prior leaves are by other later leaves, rising beyond them, at a definite period pushed off their stools, even though the saps should continue all the year round in some degree to ascend and descend, and to leave the plants what is called evergreens, the difference of the heartwood and the bark already becomes in them more distinct: but it is above all in those vegetables in which, long before the new leaves of the spring make their appearance, the old leaves of the previous autumn are by cold made to have their fluids torpified, their solid forms detached from those of the supporting branches, and these branches for a long time stripped of foliage—and which thence are more decidedly called deciduous—that the distinction between the heartwood and the bark becomes more fully marked.

In many vegetables in which the warmth of the summer alone had kept a portion of the saps sufficiently liquid to let them ascend and descend, and feed and renovate the parts already solidified, the winter's cold congeals all the remainder of the saps to such a degree, that these saps cause in their solidification, and in the new arrangement this produces, the former cells in which this solidification takes place, so to distend as again entirely to separate, to break and dissolve: when by the frost the vegetable again has the coherence of its parts, and the life that depends thereon, entirely made to cease.

In vegetables more hardy, more tough, more cohering, and more able to resist the winter's cold, this dissolution does not take place. In many vegetables in which only the former leaves are by new leaves developing beyond them made to intercept and monopolize all the influxes from air without which ought to go on feeding themselves, left, even in the height of summer, to starve and decay, the branches that bore these leaves still remain uninjured: and even in many vegetables, in which the former leaves are, even before the new leaves expand, more prematurely by the very cold torpifying the saps that rise in them left to starve and drop off long before the new leaves appear, while the tenderer leaves are thus cut off, the robuster and less penetrable branches remain able throughout the winter to resist the effects of external cold, to protect the fluids flowing in them, and from year to year to produce new leaves and roots, which give increasing growth and extension.

CHAPTER XI.

In organized and living entities of the vegetable sort the saps descending are by partial impediments and breakings out, and the saps ascending by partial obstructions and accumulations, made to form, to the more essential parts internal or external, partial additions or excrescences.

Many plants, nay animals, cause certain of the fluids they inhale from air through their leaves, in their descent downwards to pass out through their tracheæ or transverse ducts, and at the orifice of these tracheæ to elongate in tubes or prickles, from which, while the hard sheath often occasions a wound, the fluid running out through that duct, flows into that wound, Other plants, when from the branches and stem they again exude substances which they took in from air through the leaves, have these substances by pressure from without so moulded as to form stipulæ, brachteæ, tendrils and claws, which, formed out of the descending residue of the leaves are, in fact, themselves only abortions of leaves. Of these some are made by the pressure from without to take such a form as, when from one side pressed against a solid body, on the other side round all the convexities and concavities of that body so to cling as to buoy up against it the very stalks of the plant from which they proceed. Others are, by sucking in the air from bodies to which they adhere, even made to cling to such forms as are quite smooth and polished.

In some vegetables the vessels from the roots arising experience in their way upwards to the leaves obstructions or strangulations, which cause the saps flowing in them to be arrested and made to produce local accumulations and swellings, often by man for peculiar purposes of his own much prized and praised, and, by his care in overfeeding the plant, increased to what in himself would be called dropsy, and what even is, relative to the plant itself, a defect or a deformity.

Such are in certain solanums, turnips, radishes, carrots, beetroots, celery, parsnips and others, those enlargements, remaining chiefly cellular and parenchymous, in the potato plant formed near the very extremities of the roots, where these roots ramify downward in other later roots, and in the other plants named formed higher up, and nearer where these roots approach the strangulations in their vessels caused by the ramifications of the leaves upwards: such are in the bulbous plants those parenchymous enlargements which, as the plants grow older, are experienced in the lower leaves themselves: such are in the *chou-rave* those swellings higher up still in the stem, where that stem, arising from the lower leaves, supports the higher and later leaves; all which enlargements, as they increase, divert in their production more of the saps from underneath that would otherwise have continued to ascend till they formed the pulp or parenchymous part of the fruit or berry: and finally, such are round the more essential parts of the fruit or berry itself those integuments merely crystallized and pulpous, which, in cultivated melons, gourds, pumpkins, oranges, lemons, apples, pears, plums and peaches, and even in raspberries and strawberries add so much to the enjoyment of man, and so little to the intrinsic faculties of the plant.

There are vegetables, such as those called ananas or pine plants, in which, after the roots and leaves have produced those later parts which are called separately male or female—blossoms or fruits,—they again athwart the very stems which these form, produce one way new roots and the other way new leaves; of which the latter, when from that stalk which runs through the fruit, and put it in immediate contact with water or earth underneath again detached, immediately again push forth new roots, on the same principle on which all other buds are able to do the same.

There are other vegetables again which, composed of more nitrogen than the generality of plants, and thus in their nature and hue more approaching those of animals, under the name of fungi, are made to spread their leaves outward in the shape of a single cohering mass, or in that of a number of concentric follicles, more resembling the gills of animals: but even in these plants the formation of the roots and leaves still follows the same general rules as they do in all others, with regard to their relative order of growth and position.

CHAPTER XII.

Vegetables manifesting certain powers of movement, more generally only possessed by animals.

Certain vegetables already exhibit peculiar external movements, which, in general, only proceed from peculiar internal thoughts; and which, therefore, are apt to give these vegetables the appearance of already possessing powers of thought, and of being in reality animals.

Such are the movements which vegetables not attached to peculiar solid spots exhibit when they float about, and shift their situation at the pleasure of the winds and waves.

Such are in other vegetables the power possessed by their leaves and branches of approaching from a distance the place overhead whence flows heat or light, or the power possessed by their roots of approximating from afar the place underneath, whence flows aqueous nutriment: that of avoiding an intervening spot which is sterile, and of describing a circuit in their way to one more fertile.

Such is in certain creepers the power of turning their limbs in the direction that affords them the best prospect of support.

Such is in the sensitive plant the power, when touched, of shrinking, of closing its leaves and of drooping: in the dionea muscipula that of closing its fangs over the fly that steals the honey of its nectareum, and retaining the insect in its clutches till it dies: such is in the hydrargyrum girans the power of fanning the air in hot weather, so as to diffuse a grateful coolness.

And this idea of powers of sensation and thought residing in certain plants seems the more plausible, as there are other entities who, like zoophytes, with the powers of sensation that constitute an animal more clearly ascertained, still retain that attachment to a peculiar soil, and those forms partly aerial and partly aqueous, separate from and opposed to each other—that absence, in addition to external pores for the influx of nutriment and the efflux of feces, of an internal stomach, answering these purposes more sensibly, which from most vegetables again distinguish the higher animals.

Indeed, if the entities here described as doubtful, already like these zoophytes, derived their peculiar powers of movement from peculiar faculties of sensation, they would in reality already, like these zoophytes, be decidedly entitled to the name of animals, since organs and faculties of sensation are those that render all animals again different from mere vegetables, and that in them constitute animation.

But this is not the case: vegetables that exhibit these deceptive movements, only do so from some purely mechanical cause, which implies not any feeling. Those that, far from the light, only turn their leaves athwart intervening obscurity to where from on high that light is perceived, or that, far from water, only bend their roots, through intermediate air, to where aqueous nutriment from underneath arises, and only circuitously advance to the latter, only do so because they already, from the spots to which they advance, draw such nutriment as make them elongate particularly in those directions, even before this process yet becomes perceptible to our senses.

If in the high grass the stalks of the daisy grow longer, and in turf often mowed remain shorter, so as always to accommodate its disk to the level of surrounding solid bodies, and keep pace with them in its direction, this is only because, in high grass, the pressure of light and air that prevents the further rising of the flower, is interfered with and stopped by the counter-pressure of bodies rising from underneath, at a greater distance only from the ground than it is in lower grass.

Vegetables that far yet from other solid bodies, already turn their tendrils to these bodies, only do so because on the side of these other bodies the pressure of air to the same, being intercepted, leaves the pressure they themselves from the opposite sides experience to these bodies, to preponderate, and to drive them to their surface.

Where the sensitive, rudely touched, contracts its leaves, or the dionea, insidiously robbed of its nectar, extends its fangs over the culprit, this is only because the pressure mechanically produces these effects; and where the hydrargyrum girans fans the air, it is only because its fibres are alternately by cold compressed and by heat dilated.

CHAPTER XIII.

From the rules of nature there may be deviations; there may be defects and deformities; and as entities become more complex, and those rules thus become more multifarious, the deviations from the same may also increase.

PEOPLE sometimes imagine that things may go wrong before they go right. This, however, cannot be. What we consider as wrong can only be a deviation from what we before already considered as right; and things can only be considered as going on rightly, by going on in a certain definite way, during a period of time sufficient to consider that way as the regular rule.

But in reference to certain other portions of the universe, already created, and caused to exist, and to go on for a certain length of time, prior to the existence of this individual globe, this globe itself, which is only of a secondary and later formation, may already from its very first launching have had its imperfections and its defects.

And such undoubtedly it has, from its very commencement, already had. Irregular and faulty undoubtedly were from the first its movements, compared with those of other globes more early, more central and better poised in surrounding space; and from this first great defect, exhibited by the obliquity of its position, and the irregularity of its movements, must in the sequel have been entailed upon it a train of other defects more late, more partial, and more subdivided:—from this original sin must have flown a variety of less faults in its formations and developments mineral, vegetable and animal, physical, intellectual and moral—of which to this hour we feel the consequences.

Of these defects a part would be generic, and beset all the individuals of its different species, mineral, vegetable and animal alike. They would be part of their very essence. Such is the great defect of the component elements of each species being divided among a number of different individuals, simultaneous and successive, distinct from each other, each only singly formed of a very small portion of the elements that compose the whole of the genus, and each in its individual interests interfering with those of the remainder of the individuals of that same and of other genera, so that of the organized and living species, each individual is, after a short period of expansion and development, doomed to a state of decline, death, and dissolution, in order to make room for others.

There are other defects which are not inherent in the whole of all or of certain species, [illegible] a [illegible] [illegible] in their very excellencies, [illegible] which are only accidental, and to which may from their peculiar situation, certain peculiar deviations of such species, as individuals, are liable.

[illegible] the [illegible] congelation or crystal which, instead of, as it should have been according to rule, [illegible] to have had throughout its aggregate alternate parts and particles of a certain peculiar homogeneous substance and form, may by some accident be made to show deviations from that homogeneity, which renders it defective. It may be made to exhibit internal flaws or external lesions, which make it appear *deformed*; and as entities, substances and bodies, *in order to be formed* according to rule, require *conditions*, forms and faculties simultaneous and *successive* more numerous, more varied and more *complex*—as from inorganic and lifeless, they become organic and living, in more various ways development show a number of defects and deficiencies to which mere minerals, having no such successive growth and development, cannot be liable. However, among the very defects of vegetables—among the very circumstances in which they deviate from the acknowledged rule—there are many still which, to eyes and minds not accurately versed in all the rules belonging to the development of vegetables, and only intent on contemplating their later and more superficial effect on the sense of man, still pass for peculiar merits and beauties.

Such are in peculiar plants the etiolation of their leaves, the supernumerary petals of their flowers, the very extraordinary swell of their fruits, which renders them to us more luscious and more palatable. We admire the varied stripes of the ribbon grass, the various spots of the tulip, the golden edges of the variegated holly, the numerous petals of the double rose, the swelling pulp and succulence of the peach, produced by the Parisian gardeners. All these circumstances, in their faintest degrees already exceeding the rules of nature, are still by the art of man sedulously increased.

But in most animals the rule itself already becomes so much more evident, that in these entities, corresponding deviations from it, in general already at the very first sight pass for evident and acknowledged defects.

That peculiar deficiency in the colouring matter under the epidermis, which in the holly still passes for a beauty, in the white mouse and rabbit already becomes a very doubtful merit; in the piebald peacock and in the horse only is tolerated, and in the human Albino,—in the white man devoid of all complexion, or in the spotted negro,—is considered as a positive deformity.

All such incidents as in living entities deserve the name of defects, are caused by a deficiency of the full complement of substances, forms and faculties, which were necessary to produce perfection.

This may at first sight seem a paradox. What! is a calf with two heads on one body, a human being with two thumbs on one hand, defective from not having of peculiar limbs or features a sufficiency? was Lambert deficient in having too little embonpoint?

The individual may have more than enough;

belong to its several individuals, this only arises from substances having been employed in these supernumerary parts, which ought to have been employed in forming certain of the parts necessary to other individuals, which for want of them have not been achieved. An animal with two heads only arises from the attempt to form two individuals distinct and separate from each other having been begun, and having failed in the completion.

CHAPTER XIV.

What is it that distinguishes from entities, organic and living, called mere vegetables, those that are called animals?

What is it, I say, that from those entities, organic and living, called mere vegetables, again distinguishes those that are called animals?

Is it the faculty of arising unattached to, or of becoming detached from, any other solid body, insentient or inorganic, different from themselves?

No, for on the one hand, already many mere vegetables possess this faculty. It exists in the Chinese air plant, which can live and grow between heaven and earth, unattached to, unconnected with, any other solid body. It exists in the conferva, which to the last floats, unattached, on the liquid expanse of the waters.

It exists in the seeds of all plants that first begin in the form of a cotyledon, detached from surrounding solid bodies, even vegetable and their own parents. It even exists in those mere mineral concretions, that, without rising out of prior solid matrices, like snow spangles, like pyrites, like salt pillars, are, without any prior solid matrix as their medium, immediately formed in atmospheric gases or in terrestrial fluids. Nay, this faculty must already have been shown by the first solid substance in which began our globe, when, without the medium of any prior solid, it was seen in the midst of more extensive surrounding masses of mere water or air to arise and to consolidate. On the other hand, many animals do not yet possess this faculty. Many of the zoophyte species to the last remain connected with the insentient and inorganic rock on which they first arise.

Is it the faculty of organization, of life, and of growth which distinguishes animals from mere vegetables? No, certainly: for vegetables, in order to have a claim to that appellation, must already have organization, life and growth; and animals themselves, or at least entities destined to become such, have not yet this faculty of life in the first stage of their formation: since life is a phenomenon which depends on successive periods of time.

Is it the power of locomotion? If we mean that locomotion which arises merely from not being attached to the soil; not being anchored fast to a peculiar spot—from being, on the contrary, at the mercy of every external impulse, and the sport of winds and waves, it is not that. —Already many vegetables, like confervæ, deprived of roots that can rivet them to the solid earth, and only loosely floating on the yielding waters, already are in that predicament. If, on the contrary, we mean that locomotion which arises from an internal voluntary impulse, many animals, such as the zoophyte growing out of the solid rock, and such as the mollusca even, which subsequent ropes tie for ever to that rock, possess it not.

Is it in a form external or internal entirely different from those shown by mere vegetables? Is it in having externally, in a longitudinal direction, one way a head and the other a tail, and in a latitudinal direction, transverse to the former, both right and left lateral corresponding limbs: in having internally a cavity called stomach, through which passes a great portion of its nutriment?

Alas, no: for though as far as I know, of insentient entities—of mere vegetables—none yet ternal pores: they might only be taken for vegetables, but that they cringe to the touch.

It is not even the intrinsic nature of their component substances that constitutes them animals. Certain vegetables already have a certain portion of all the visible elements of which animals are still fundamentally composed, and all animals still to the last possess a certain portion of the elements of which the simplest vegetables already require a portion.

What thus universally distinguishes all animals from all mere vegetables? It is only as far as we can see, the faculty of showing in their first and most fundamental solid organs, though themselves yet deprived of powers of sensation, a capacity to superstruct on these other later and more complex organs, which at a certain degree of maturity, and under certain peculiar circumstances, evince such powers of sensation, never acquired by mere vegetables.

I say, a capacity, for not only in most animals the first and most fundamental organs themselves do not yet evince any actual intrinsic powers of sensation: but even those later, more partial and more complex organs, afterwards superstructed on the first and most fundamental ones, that by degrees begin to show such powers, do not yet do so from the first, nor even, when they begin to show such powers, can they do so except under peculiar external circumstances: nor do, even under these circumstances, the powers of feeling last without interruption. Other external circumstances, such as that of sleep and swoon, often interrupt their continuance: death puts on them a complete extinguisher. Yet by the custom of language, the first and most fundamental of organs of an entity in which is capable of arising any sensation, are already called those of an animal, and the last and most superficial of shapes in which any of these organs continue to be recognised, even after death, still bears the name of the organs of an animal. We call wool and feathers, even when collected in a pillow, animal substances.

As to what sensations themselves are, this I shall endeavour to explain more fully at a future period, and where they come into actual play. The word is sufficiently understood for my present purpose.

Now, whence comes it that, on the one hand, No; for we still find sentient entities all fundamentally formed of the very same substances of which already are formed organized entities not sentient. Certain mere vegetables, such as the acrid cruciform already possessing even of nitrogen—that substance regarded as most prominent in animals—a quantity nearly approaching that in which it is found in many animals.

Still is already nitrogen from the very first found in the composition of all animals, in greater quantity than it is found in that of any vegetables; and there may, besides nitrogen, exist certain substances not found at all in vegetables, but necessary to the composition of animals, which to this day have escaped detection.

It seems thus fair to suppose that, while mere vegetables are from the first only composed of substances of such a nature and in such relative proportions, as when solidified, offer not yet elasticity sufficient to permit the addition of those other substances which alone can form organs of sensation, the very first elements of which are composed animated forms, already, from the greater number and variety of substances, or the greater proportion of certain of the substances, of which they are composed, allow, when solidified, of showing that greater openness, those interstices more varied intervening between their solid parietes, that superior elasticity, necessary to admit of the later superstructure on them of those other organs in which alone inhere immediate faculties of sensation: that the first and most fundamental saps formed in the very cotyledon, ovum, or placenta of an animal, and of which the part, by the pressure of the centrifugal force from without made to ascend, mixes with new aerial particles in the compound again redescending called lymph, and the other part, by the pressure of the centripetal force from without made to descend, mixes with new terrestrial or aqueous particles in the compound again reascending called chyle, already, by containing more nitrogen than mere vegetable saps of any sort contain, cause the first difference, and lay the foundation of the future greater ones, which distinguish mere vegetables from animals —that only from the peculiar nature of those saps called lymph and chyle proceeds their later remixture with each other in a tertiary sort of fluid, not possessed by mere vegetables, called blood, which, composed of portions of lymph and chyle mixed, does not yet in the earliest and simplest of animals in which it is found, yet differ much, either in substance or in colour, from either of the two fluids of whose mixture it is formed, taken singly and separately.

I do not mean to say or to imply that we can by this explanation be made to understand why and how these same substances in which, when mixed in certain proportions arises no power of sensation, when mixed in other different proportions and dispositions, rendering their mixture more elastic, arises such a power. Whence arises in matter the capability of acquiring, under certain combinations, powers of sensation, not acquired by it under others. This circumstance must still remain among the secrets of Providence concealed in the first unknown attributes of matter. I only mean to state by what media such an event as the possessing the faculty of sensation is directly brought about.

After describing somewhat more circumstantially the nature and movements of the blood, I shall hastily survey the new forms, still insentient, in which the new proportions of certain substances may make them develope in those entities collectively called sentient, before I pass over to the organs of direct sensation, again on these organs themselves still insentient in their turn superstructed.

We shall see that while there are entities in which a substructure of organs still insentient, very simple and restricted, already suffices to bear a superstructure of certain organs sensitive, and even probably intellectual, other entities, like man, have a substructure of organs insensitive, very wide and complex, before on these again arises a superstructure of organs sensitive and intellectual; but in these more complex entities the latter sort of organs, founded on a broader base, itself becomes more varied and developed.

CHAPTER XV.

Blood; its component substances, forms and movements.

That in every animal only of the first and most fundamental fluid, itself half of elements from air descending, and half of elements from earth ascending composed, and of that animal forming the first solid parts cotyledinous, cellular and vascular, a part again, by centrifugal gravitation driven upward, was, with fresh elements descending from air, combined in that secondary fluid called lymph, and another part again, by centripetal gravitation driven downwards, was, with fresh elements ascending from earth, combined in that other secondary fluid, different from the former, called chyle: and that of this lymph and of this chyle portions again being made to meet, were combined together in that compound of tertiary formation called blood, appears from the relative order of birth of each of those fluids; and from the later ones being each composed of elements of the two former. Precisely however, because the chyliferous and lymphatic cells and vessels lie deeper than the blood vessels, do these latter, when inflamed, conceal and eclipse the former. Of the blood itself the arterial sort is again composed of a part of that called veinous, again driven upwards and outwards, and again mixed with new elements flowing in from air, as appears since, while veinous blood often is found in animals without arterial blood, arterial blood never is found in animals, except prior veinous blood already had been formed and made to supply part of its elements.

At the same time, however, though in every entity organic and living we call every fluid, following the same order of formation, by the same name, it is to be observed, that in every entity organic and living generically different from another, the very first as well as each later species of component element, force, substance, proportion, form and movement, radiant, gaseous, fluid and solid, must already in some particulars be generically different from the substances bearing the same name in each other different genus, however much they may still bear the same name: since it is only out of their first generic difference in these respects, that arise all their later generic differences.

Thus already in every animal generically different from another animal, the first and most fundamental fluid, composed of elements half aerial and half aqueous, which afterwards again, [illegible] [illegible] [illegible] different from each other, [illegible] [illegible] becomes half lymph and half chyle; [illegible] [illegible] after that again, if part of this lymph [illegible] part of the chyle in its turn formed; and [illegible] [illegible] that part that remains veinous, [illegible] [illegible] that again by fresh remixtures with [illegible] [illegible] [illegible] must each already be formed [illegible] [illegible] in their nature, or at least, in their [illegible] [illegible] different from those of which they were formed in the other animal.

[illegible] that this is actually the case, we see, since the [illegible] [illegible] or chyle, or blood of some animals [illegible] acts as a poison on other animals of very different genera.

The same again remains the case with all the [illegible] fluids, such as bile, saliva, &c. again in their [illegible] [illegible] [illegible] [illegible] out of the blood.

[illegible] [illegible] itself—the first fluid which bears the name of blood—seems already formed of the mixture of many substances, supplied by the lymph and chyle: some of these are already separately in this very fluid consolidated in lesser solid forms, and while the others remain fluid, float in their mass, and by it are carried on, till they are again by surrounding pressures made to cohere in more considerable aggregates.

The serum, one of the two most fundamental constituent part of the blood, is supplied by the chyle. The fibrine, which forms its other constituent part, is supplied by the lymph. This latter is consolidated in globules which continue floating in the serum, till again by it given off, and made further to cohere into muscle.

It has been asserted that in an animal, from the first moment it acquires any blood, this blood begins to circulate: that is, to move forward, till, having described a complete circle, less or more extensive, it again ends its course where it first began that course.

This I greatly doubt.

Firstly, there is no precedent for such a circulation in any of the earlier fluids in nature, which seem to have a similar origin, and to serve for similar purposes of successive increase and development.

All these fluids not only, as far as we can see, begin in something earlier and simpler than themselves, and are made to move forward, not merely in order to circulate to no purpose, so as again to end where they began, but on the contrary in order to combine in their progress in something again later and more complex than themselves.

This already is the case with the earliest, most simple and most universal of forces and substances which we know. If gravitation, if electricity, if cold and heat, light and colours, and other forces and substances, even still only radiant, move and advance—if from general space they enter certain bodies, it is only in order in [illegible] more condensed, [illegible] undergo a [illegible] new faculties, and [illegible] peculiar [illegible] in order [illegible] phenomena in other [illegible]

[illegible] we see in its first [illegible] most general element [illegible]—in that [illegible] medium, [illegible]—a [illegible] movement [illegible] from earth [illegible] is not a mere circu[illegible] progress, at every [illegible] on the one [illegible] fed, sup[illegible] the other [illegible] bodies mi[illegible]: so as to [illegible] different from [illegible] air, and having [illegible] processes.

[illegible] same [illegible] earthly fluids, mineral, [illegible] again more late and partial [illegible] earlier and more general [illegible]. All these, whether mineral fluids, vegetable saps, or the lymph and chyle of animals, in their course, give of certain of their former parts, and have their quantity kept up by new parts, from simpler elements again added: and this cannot be called a complete circulation, by which again must be given up, in statu quo, all the materials furnished.

Secondly, such a complete circulation could have no object, could serve no purpose. It could only at the end of its course have matters restored as they were at the beginning: whereas blood in its movements is intended to take in elements by former fluids supplied it; to give off other elements by it carried along, in order to have these assimilated with the solids that want such for their support; to take in other elements already solidified, which again become fluidised and superfluous; to expel these from the body; and in all its movements to perform some purpose of nutrition, renovation, or ejection.

Thirdly, such circulation is not even confirmed, but is contradicted by the very inspection of the blood itself.

In the ova of animals the existence of blood first begins in different disconnected points. It forms different disconnected vessels. In its first stages it can only in these vessels necessarily make a short and partial progress, before its course is again stopped, even where afterwards it might, by the more generally increasing connexion of these vessels, acquire the means of the most perfect circulation. It can thus never in its first stage show that circulation. In many simpler animals it never even attains the faculty of performing a complete circle, nor even in those in which it later attains this faculty, does it, in the natural state of the body, exert it.

If in higher animals, at a later period of their development, when any vein or artery is punctured, the blood ceases not flowing out, as long as any blood is left in the body, even this does not prove that in its natural state, every part of the blood that was at one time in one part of that body necessarily in its turn does and must visit every other part: it only proves that by the providence of nature, if any part wants its natural supply, it can, by participating in the supply yielded by another different part, be provided. Of what use, if naturally each particle of blood visited every part of the body in turns, would be local bleeding?

Blood in higher animals only appears to offer the complete circulation which it naturally performs not, because, as in all liquids, no line can be drawn between that part which is added, that which remains, and that which is given off, in each peculiar part of the body, and because the substance, form and colour of each part of the blood, to the sense, still resembles that of every other.

Blood, however, must in its course ever remain subject to be changed, given off, and replaced by fresh blood; and as such, cannot be said necessarily and naturally to offer a complete circulation, which means, after a certain intervening portion of time, a return of certain elements, unchanged in quantity and in quality, to the identical place whence they first started.

In all animated entities, however, the blood, without ever naturally attaining a complete circulation, soon naturally acquires two different movements. The one is an advancing movement from one place to another, produced in the blood by the earlier pressure of the elements that form and that supply it, and which enable it in its turn to deposit in different places some portion of its own substance, to convert this substance from fluid into solid, to take up in its way other substances again from solid converted into fluid, to eject them, and thus to forward the functions of life, growth, elimination, renovation and gradual decay.

The other movement of blood, and which causes the former progress itself to be carried on with greater vigour, is, if I may so call it, a stationary movement—a movement on a pivot of its own. It is the continuation and development of that movement which already is exhibited in the tides of the sea. It is that movement caused by the pressure of the atmosphere without on the blood vessels within, which makes them contract, till, by their very contraction acquiring more power of resisting and counteracting it, they again dilate, expand, in expanding weaken in their resistance, in the same proportion that air without, contracting, becomes stronger in its pressure, and thereby become exposed to fresh contraction. This movement, called pulsation, already in a certain degree existing in all bodies of an elastic sort, especially in vessels possessed within of a considerable void, becomes more sensible as these vessels become more elastic.

As to the red colour, it only begins in the blood of higher animals: and as to the sensible heat, it only, as in the other fluids of organized animals, increases in their blood in proportion as vitality becomes more active.

I have said that in many inferior animals the blood remains to the last entirely veinous: and already of the veinous blood a portion again discharges part of the carbon it took in from without, through the lymph, in the shape of that fluid called bile, which forms the liver, and is in part again discharged through that liver.

In higher animals, of the veinous blood driven upwards and outwards, a part is again made, by the pressure of external air against its carbon, to form a part of this carbon into tracheæ, and through these tracheæ to discharge another part of the same into air, while from that air it again takes in part of its oxygen. This new mixture is, by the continuation of the same pressure from without that formed it, made through the same tracheæ to re-enter and redescend in the system, under the name of arterial blood.

At last, of the blood both arterial and veinous, of which a part has served to renovate and increase the body, the superfluous residue is again driven outward, and in its exit made to form the vessels called capillary. Never through these capillary vessels does it re-enter the system, except in such cases of inflammation as cause a rupture in the parietes that separate these last of vessels, called capillary, from those called chylific and lymphatic, through which the elements of blood first enter that system. Regularly the residue of the blood is again through these capillary vessels, and through the orifices or pores which terminate them, re-exhaled into that atmosphere from whence its elements first came.

CHAPTER XVI.

Glands and tracheæ.

When substances from without an organic and living body flowing inward, are in that body met by obstructions from within, which of these substances arrest a part, this part from fluid is first condensed into a cellular solid called gland, of which gland parts are again, by the fluid continuing to flow in them, moulded into vessels, and through these vessels the remainder of that fluid from without is again driven inward.

When saps from within an inorganic and living body flowing outward, are in their way out met by obstructions from without, in the shape of fresh aerial elements coming in, they are, from fluid as they were, with part of these new elements round the column they form condensed in a cellular tube called trachea, of which parts are again, by the fluid continuing from without to flow in them, converted into vessels, and through these vessels part of this fluid from without is again driven inward.

The solid gland is a mere secretory and excretory organ, but the hollow trachea, in its earliest parts an excretory organ and spiraculum, also in its later parts and offices becomes an inhaling organ.

Such organs are in vegetables the roots through which of the fluids going out downwards a part, again by new aqueous elements from the earth underneath ascending arrested, is with these recombined, and again by them driven inwards and upwards.

Such are in vegetables the leaves through which of the fluids going out upwards a part, again by new aerial elements from the atmosphere above descending arrested, is with these recombined, and again by them driven inwards and downwards.

Such, lastly, are in vegetables the organs formed by the saps vertically ascending and descending which, meeting and arresting each other, between the former opposite vessels form new parts cellular and vascular, through which the residue of those two saps united in them is again carried out in a transverse and horizontal direction.

In animals the lymph and the chyle, through the lymphatics and chylifics running inwards, are made by their meeting to form glands, in which their different natures blend and combine in blood, first veinous, which again runs out of them, and again experiences fresh decombinations and recombinations.

[illegible] blood, at first all veinous, a p [illegible] meets with a resistance th [illegible] of its carbon, in the shape of [illegible] solidifies part of that fluid i [illegible] and next endowed with [illegible] through which the remainder [illegible] is vented and made to run ou [illegible] blood, first all veinous, a part, [illegible] outwards, again meets [illegible] carbon a part is again by the resistance of that outer air round a column formed by the rest made to consolidate in the shape of a trachea, through which the remainder of that superfluous carbon flows out, and oxygen from without flows in, and with the residuum of the veinous blood combines in an arterial shape, in which it is again driven into the body: and the alternate periods of emission of the carbon from within, and of the introsusception of oxygen from without, are those called of exhalation and of inhalation.

are taken in new quantities of aqueous food, and those called broncheæ, through which are taken in new quantities of aerial food. These stomachs, when they elongate anteriorly, have their later elongation and more external outlet called throat and mouth; and when they elongate posteriorly, have their later elongation and more external outlet called bowels and anus: and these broncheæ, when they elongate anteriorly, have their earlier and more interior parts called lungs, and their later and more external elongations and outlets called Eustachian tubes and ears. In animals higher and more complex, these tubes become partly choked up and closed, and force the aerial elements from the lungs to go out of, and the aerial elements from without to flow in, through the duct of the throat, and the passage of the mouth or nostrils; and leave the ears merely subservient to the purpose of affording a seat to the organs of hearing.

As animals are first formed in water, in air or between these two elements, the pressure from without upon their tracheæ, and the counter-pressure from these tracheæ again outward, makes these channels become deeper and longer. In fish they extend inward into air bladders, and in birds even into the very tubes that penetrate in the feathers: and these ramifications of aerial elements lighten the animal in the fluid in which it moves.

CHAPTER XVII.

Most animals still have a considerable substructure of organs and parts vital merely insentient, before on these they again superstruct parts of a sentient nature.

For reasons of which we feel not yet the full cogency, except that it could not be otherwise in the mechanism of this world, many animals, and those especially of the higher order, have yet their organs of a sentient sort—the first on which depends with their feeling their felicity—only superstructed on an immense base or scaffolding of organs of vitality, wholly insentient, which precede and support them; and of which I shall here give a sketch, before I pass over to those of a sentient description.

I shall however caution my reader that of these mere vital developments and changes many already take place while the animal still lies in the concealment and under the cover of the ovum;—nay, while these developments still remain to us liquid:—before they yet acquire that consistency which enables them to become distinguishable to our sense; and especially before they are disclosed to the eye, by that maturity which makes them cast off the egg-shell: and I shall add, that the more complex the animal becomes, the more numerous and varied are the changes and developments by reciprocal pressures and counterpressures produced, which thus take place, and wholly change the appearance of the animal, before it is permitted to issue forth from the ovum; and of which, consequently, when it starts forth into day-light, the commencement and the progress are already past watching.

The earliest and simplest of entities which to their forms merely vital seem to add forms sentient, seem still to retain vital forms entirely similar to those of the organised entities that have none other. Of the entities that under the name of zoophytes still, like mere vegetables, through their external pores alone, carry on all the processes of vitality—absorb from without all the nutriment they want, and again emanate outward of that nutriment all the superfluities:—none yet appear to have any internal cavity called stomach, nor any external protuberance called head. Rooted in the ground, and deprived of powers of voluntary locomotion, they might still be mistaken for mere vegetables, did they not seem to possess powers of feeling, and when grasped, to shrink from the touch.

But next to those simplest of animals are seen to rise others, already formed of substances whose relative proportions render them so much more elastic, so much more yielding to pressure from without and to suction from within, that by these they are soon made to receive, in addition to their external surface, an internal dip, or dent, or infolding of that surface, which, as it elongates inwards, becomes a bag, a stomach; and in this stomach, of the exsudations from within the body, before confined to the external surface, a part now also again re-issues outward under the name, no longer of mere transpiration, but of gastric juice.

When, afterwards, the first organs of feeling begin to experience the want of taking into this stomach external substances of the same sort, but more substantial than those that can be taken in through the mere external pores, and cause the orifice of this stomach, called mouth, to expand over these external substances, to cling round them, and to take them in, the gastric juice collecting in its deeper internal void dissolves these, and renders the part of them wanted within, capable of being by the pores of this cavity absorbed: while the superfluous part is again by pressure from within against the coats of this stomach repelled outward, and made to be thrown up through the same orifice through which they were first taken in; and which, consequently, after having first served as mouth, now serves as its reverse.

[illegible] from the more [illegible] made [illegible] mouth [illegible] around its [illegible] the name [illegible] fingers, [illegible] serve to draw them nearer to the [illegible] objects that are within their circumference, to bring round them, and to press them into their stomachs: and which thus hold them [illegible] fingers and [illegible] and nourishment.

In other animals, composed of [illegible] wove together in forms still more elastic and yielding, the cavity of the stomach is pressed downward and perforated into an entire tube, with a second aperture opposite that from on high, which latter faces the earth: and when food is taken in through the former, and is in the cavity of the stomach through the gastric juice from its surrounding particles flowing into the same, decominals, of part of these different external fluids taken in, the later remixture inside the body into a new compound is called veinous blood.

With these external elements taken in at the internal pores of the stomach the same is the case. One half derived from on high forms lymph, and the other half derived from underneath turns to chyle—namely, lymph and chyle. The two different fluids, which also are remixed in blood, are, however, little distinguishable, and are all driven to a common place of rendezvous, or reservoir, called thoracic duct, where they are first mixed in the shape of blood.

As I observed before, of the veinous blood, partly nearer the external surface, and partly in this thoracic duct formed, a part, driven downwards, is made again to discharge the carbon it took in from air through the lymph in the form of bile; of which bile, a part consolidates in the liver, and another part is again by that organ vented and made to flow further on.

Of the veinous blood another part again driven out upward, is again made to discharge its carbon in outer air, and from that outer air to take in finer aerial elements, such as oxygen, in greater quantities, and with these again by the pressure of air from without to be driven downwards and inwards, in the new shape of arterial blood.

I shall add, that in proportion as water, land or air are in a greater degree the first cradle of the deposits whose meeting first forms animals, these animals are not only made first to receive particles aqueous and aerial, but next, to want of these for their further support and growth, fresh supplies in relative proportions equally different.

Already mere vegetables from the substances which they take in from air, again drive out a part which, round their more early and fundamental organs, consolidates and crystallizes under the name of wood, and gives these earlier parts, with more firmness and more strength, more ability to perform their various functions.

Animals in the same way again drive out part of the fibrine, taken in through the lymph, through the medium of the blood, and again in the lost corners of the frame, where they are left to collect, consolidate and crystallize these portions of fibrine under the name of muscle, of which the texture preserves great elasticity and susceptibility to be by the pressure of air, and the resistance it offers to that pressure when carried beyond a certain length, alternately contracted and expanded, and of thus communicating that motion called pulsation, from external air received, to the more internal vessels round which the muscle is formed. Thus is communicated to those vessels and to the fluid contained within them, the movement of pulsation, and its effect on fluids. This pulsation, where muscle becomes more directly exposed to outer air, becomes palpitation; and when muscles become affected by the later fluid from within which causes the sensations of will, their elasticity powerfully assists the contractions by that fluid occasioned in them.

Of this muscle, the portions situated round the principal blood-vessels, both veinous and arterial, by degrees become what are called hearts.

In all animals, from the stomach and the tracheæ, which are more early and fundamental parts,—the one sort in greater proportion formed out of the elements from earth ascending, and the other sort in greater proportion formed out of the elements from the atmosphere descending,—are, by the pressure from without inwards being made to recoil outwards, made to form and to elongate outward, first one way, and anteriorly, the throat and orifice called mouth, and the other and opposite way, and posteriorly, the bowels and inferior orifice.

And from the counterpressure which these elongations anterior are again made to receive from without, are again made to arise the lateral pressures outward, anterior, which form the tracheæ and the elongations which end in the anterior side limbs; while from the counterpressure which these elongations posterior are again made to receive from without, are again made to arise the lateral posterior pressures outward, which form the tracheæ and the elongations ending in the posterior side limbs.

I have, however, already observed, and I here again repeat, that according as animals are first formed in an element denser or lighter—are first formed in water, on land, or in air—and thus continue ever afterwards through the less or greater elasticity of their component solids to receive a pressure and influx of further elements from without inward, less or more copious and rapid, this pressure and influx from without inward of a centripetal nature less or more forcible, when, in its shock with that coming in from the opposite side it is made again to recoil outward and to produce a force, movement and afflux in a centrifugal direction, also again in its turn cause a centrifugal pressure and movement outwards less or greater; and thereby causes the animal by degrees from his more early and central parts to push and put forth outward features and limbs, offering a less or a greater elongation outward, and again, by a counterpressure from without more forcible and more subdivided, ramifying further outward more curiously and minutely.

This we find to be the case.

In the animals lower or higher—endued with fewer or more internal parts, still first formed and continuing to develope in that denser element water, when they first out of their fundamental cotyledon, seed, placenta or ovum, develope in the later parts proper, whether it be of mere mollusca, of fishes, or even of cetaceæ, still out of their different tracheæ elongating outward form no projections, no features, no limbs, advancing beyond the general outline of the animal. Oysters have not yet any distinct external features or limbs. Even the fish of the deeper waters still have no face. The extremities of their most prominent tracheæ still lie close to their bellies. The very highest of these entities can still hardly be said to have a head wholly distinct from the body. The same is the case with their tail: and their lateral limbs do not yet peep forth beyond the general integument of the skin. At most through this skin flow out those exsudations that consolidate in fins. All their external parts are still smooth and slippery: they become not covered with that down, that fur, those feathers that only grow on animals more aerial.

In amphibia the development of the limbs already is greater: still greater is that in animals first formed between earth and air, and it is greatest of all in those that, like insects and birds, are formed in purest air.

In these later animals the tracheæ and spiracula, by the centrifugal force formed, grow more into features and limbs, in extremities anterior, posterior and lateral very elongated. They have a head very distinct, and in that head the fluids exhaling from within are with new increments from without made to form excrescences of different sorts—proboscis, antennæ, eyes, &c.—very developed. In the body likewise the fluids exhaling with new increments from without, are formed into wings very wide and legs very long. These parts again in their turn become covered by a thick tissue of down, hair or feathers.

Nay, those animals that, first formed in the denser element, by the rapidity with which they inhale and feed on its grosser elements, soon find themselves capable of rising to a higher abode, also soon exchange their sleeker and smoother exterior for the parts more projecting, in their new abode wanted, and by their new abode produced.

Of elements, from external air first through the pores of the skin inhaled, condensed into lymph, and through the body circulated, while a part is with chyle combined into blood, another part is again through the coats of the stomach exsuded under the name of gastric juice; and another part is again later through the later and higher coats of the throat and mouth exsuded under the name of saliva. When afterwards the animal is launched into outer air, and these juices become more abundant, of the food sucked in at the mouth the saliva begins, and the gastric juice completes the decombination, ere of this food part be by the coats of the stomach absorbed, and made to enter the system.

CHAPTER XVIII.

In proportion as of organic entities the first solids are by their greater elasticity suffered to absorb later succeeding elements, with more ease and in greater quantities, these later elements of each sort are also left to remain less divided, dispersed, weak and resisted, and are made on the contrary with these former aggregates to compose later solid aggregates more united, more forcible, more pressing upon other different neighbouring aggregates equally forcible with themselves, and are also more in their turn by these other neighbouring aggregates pressed upon.

In the earliest and simplest of entities in which appears an organ of any peculiar sort, of that organ the materials and molecules, still only finding in that entity less elasticity, less readiness to receive them, still only enter in portions very minute, very much resisted and divided by the solids already formed. They still only in that entity of that new organ form at great distances specimens very small, very weak, very much divided, very numerous and very inefficient: they press little upon their neighbours, and are by these neighbours greatly resisted.

As organized entities in their first foundation are higher, more complex, and more elastic, they offer in them room and means to receive the new elements capable of forming in them these new organs in quantities less divided, less dispersed, less weak, larger, more condensed, more collected in a single spot, more possessing the faculty of pressing forcibly on other neighbouring organs, and more liable also in their turn to receive from their neighbours a counter-pressure equally undivided and forcible.

This already is seen in the earliest organs of mere vegetables. Their tracheæ downward, which, with aqueous elements from underneath rising, are fed and formed into roots, and their other tracheæ upwards, which, with aerial elements from on high descending, are fed and formed into leaves, still are seen each to increase in indefinite numbers, but to remain individually very small and weak.

Even in entities of a sentient sort most simple—in those that, under the name of zoophytes, still in their growth resemble mere vegetables most,—this still is the case. Their roots, their branches, their stems, their spiracula still often are in indefinite numbers, but individually very weak and inefficient.

Nay, in mere vegetables, the higher and later parts of which we shall speak afterwards—their flowers and their fruits,—still arise in indefinite numbers.

In all entities that, out of the mixture of part of their chyle with part of their lymph, acquire any blood, and any vessels conveying such blood along, these vessels are first only made to arise on points divided and separate from each other. In many inferior animals these veins never afterwards are made to communicate. It is only in higher entities, that by a pressure more forcible and general, they are by degrees made to run together.

Of the blood, at first all veinous, portions again from within driven outwards are, in simpler animals, only made to exhale their carbon in outer air, and from outer air to take in fresh oxygen, in tracheæ still very small, very numerous, very widely dispersed through the system; but still individually very weak and very inefficient.

Only in higher animals, of these tracheæ a certain number are compressed together and made to unite in fewer and more capacious broncheæ; and of these broncheæ again the channels by further elongation outward grow deeper inwards, and give the earlier and more internal fundamental parts more the character of lungs.

In the simplest animals in which from the elements, exsuded by the blood veinous and [illegible] is formed any muscle, this muscle still is at loose and not close and compressed. As by vessels more numerous more muscle is assumed, its mass becomes more close and compressed. In the simplest animals in which any muscle is visible, none of that muscle yet assumes the decided character of heart.

In the animals least complex in which any muscle already acts in the capacity of heart venous and arterial, there are many such hearts widely separated from each other, but each yet little active, little defined, and only keeping up a low pulsation. In animals more complex the materials of all these hearts are compressed in only two organs of pulsation very powerful, one venous and the other arterial, which again are huddled close together in a single aggregate.

It fares the same in animals with the organs sensitive, intellectual and reactive, again superstructed on the more vital organs.

In animals still more complex these pupils become restricted to a single pair.

The organs of intellect are likewise in lower animals divided among a number of smaller ganglia, dispersed all over the body. In animals more complex they are chiefly reduced to two larger lobes driven to the brain.

The very organs of voluntary action outwards have the same fate. In inferior animals they are extended over a long proboscis, and large antennæ. They are divided between many features, many limbs, each less defined in their use, less exclusively fitted for their purpose. In higher animals they are each reduced to the two halves of a single whole, or to a single pair. While the millepede has a thousand crawlers, man has only a single pair of hands and of feet.

It should even be observed that while a plant singly has a thousand different specimens of the organs of generation,—of fruits and of flowers;—each higher animal singly has only a single specimen of either or even a specimen only of one of the two It is only exclusively male or exclusively female. Of that we shall afterwards show the cause.

It must, however, be owned that if on the one hand the different organs of organic entities, when they are of this latter sort—when they are few but highly finished,—as long as they endure, perform their office best, on the other hand when they are injured or destroyed, leave their loss most reparable.

That same greater activity and pressure of all the vital fluids which, while each continues to flow in its proper organs, continues to give each organ more swell, more elaborateness, more power, when any organ is injured and lost, makes every neighbouring organ so much sooner invade its room, and occupy its elements still circulating to flow in it, as to make them convert these elements sooner to their own use, and leave the organ lost a less chance of being replaced.

In a polyp or zoophyte certain ramifications which are lost are little missed, and are easily restored. Such entities are not yet liable to curtailment or dismemberment.

Of the polypus the external parts turned inward, and the internal parts turned outward, each easily assume the functions and replaces

But as soon as animals by the multiplicity of their first component parts, contending with each other for superiority, have become vertebral, and have had the locality of each later part so defined, that as soon as one organ is lost, all the other neighbouring ones vie to invade its site, and to absorb its nutriment, there only remains, where it is lost, room for the replacement of mere intervening expletives.

CHAPTER XIX.

A few presumptive proofs of certain of the foregoing statements.

Before I proceed further in my long-winded series of inductions, and begin upon the topic which comes next in the order of natural developments—that of the organs and faculties of sensation which arise out of the prior modifications of matter inorganic and organic,—let me here, respecting the origin and developments of that matter inorganic and organic still insentient, resume some of the former proofs, and adduce some further proofs, at least of a probable sort.

That from the first creation only out of opposite forces, from points of time earlier and from points of space more external and more distant made to converge inward to points of time nearer and to points of space more proximate, till by further pressure from behind, and by first meeting and resistance from before, they were again each made to recoil, to diverge, and in later time to recede further backward and to a greater distance from each other, arose all forces from a more restricted inward centre radiating to more external and distant extremities, is a truth which appears evident, since to this day only, after forces have previously from without radiated inwards, and resisted each other, forces from within are again made to radiate outward, and to fly from each other.

That only where forces of gravitation, from centripetal made to become centrifugal, in their way outward are made again to meet with, and be resisted by later forces centripetal from without converging to that same centre, they are by pressure from behind and resistance from before, made, from their direction perpendicular to each other, to diverge right and left in a direction transverse to, and at right angles with the former, in which, advancing outward, they are made to cut across the remainder of these former, arises the new and more circumscribed force called of electricity, appears since, within forces of gravitation centripetal and centrifugal, forces of electricity arise later and more partially, and thus seem to arise out of nothing else prior and more external besides those forces of gravitation themselves; and since they still receive from behind, and give to entities before them pressures resembling those of gravitation, but moving in directions different from those of mere gravitation, either centripetal or centrifugal.

That only of forces of electricity from opposite points of space advancing to each other, so as to compress intervening forces between them, consists more proximately, and thus of forces of gravitation centripetal and centrifugal from opposite points of space advancing to each other consists more remotely the force called of cold, which compresses substances from radiant into gaseous liquid and solid, mineral, vegetable and animal, appears since all cold, and all combination of substances radiant in substances more solid, is preceded and accompanied by electricity.

That only out of other forces of electricity, after they have from outward and more distant opposite points of space so come in collision, as again from more internal and nearer points of space to be forced outward in a centrifugal direction, and to cause the substances, by the former electricity productive of cold compressed, again to be dilated, separated, and pushed asunder, arises the force giving the sensation of heat, and the decombinations and dissolutions of substances by that heat produced from a form solid into one liquid gaseous and radiant, appears since all dissolutions of substances more solid, into substances more attenuated, is likewise preceded and accompanied by electricity, but of a sort different from that productive of cold and combination.

That substances before radiant are, by the force of electricity productive of cold, compressed in molecules separate from each other infinitely minute, before, by later forces of cold supervening, these molecules are again collected, compressed and combined together in later and larger solid and cohering bodies—that all cohesion of molecules in later and larger solid bodies, is only the effect of a relative arrangement of these molecules, by which arrangement they come in certain peculiar directions in greater contact, and thus in certain other directions return to greater separation from each other, and thus experience on different sides a pressure unequal and unbalanced, appears since molecules before gaseous, when from a state of mere collapsion and liquidity congealing into solid bodies, are again, in consequence of that more definite and peculiar relative disposition of their individual forms relative to each other, which they are made to assume, collectively also again made to occupy a somewhat wider space.

That molecules of substance, when by heat penetrated, are by its force distended and dilated, before they are entirely dissolved and made to separate and to lose all cohesion, appears since a piece of wrought iron, which, while by cold compressed, passes through a hole of a peculiar diameter, when become hot, no longer can be made to pass through the same aperture; and since substances, by cold which diminishes the interstices between their molecules, rendered rigid, by heat which increases these interstices is again rendered pliant; and since the strings of a harp, tuned while the air of a room is cold, when, by the influx of company desirous of enjoying the music that air becomes heated, often again through the relaxation of its strings becomes untuned.

That it is not the different degrees or quantities of cold or of heat which are retained in different external substances or bodies, and which reach not our organs of sense, but those quantities of each which precisely again from these bodies issue and penetrate into our organs of sense, that we feel—that it is the different quantities in which, and the different degrees of rapidity with which, of the cold or heat contained in certain bodies a portion again issues from them, and enters these organs, that makes these bodies, on approximating or touching them, feel colder or hotter, appears since when barefooted and in the same general temperature we step successively upon substances like carpets, boards, bricks, stone and iron, each letting out a degree of cold, greater than the feet contain, with a different degree of rapidity, they will all alike still appear colder than these feet, till by letting out more of the cold contained in them into those feet, and extracting and taking in more of the heat first contained in those feet, the whole of the heat and cold contained in each is so equalized and balanced, as no longer to let any from these external bodies or substances pass into the feet; and since both the cold of ice and the heat of iron fused may in each substance be preserved longer, and longer be prevented from all evaporating from it, from penetrating into the hand, and from being felt by the organs of touch, when that ice or that iron are enveloped in such another substance, placed between itself and that hand, as, like wool, is slower in conducting the cold or heat out of it into that hand; and since in the same way, in the human body, in winter the heat, and in summer the cold from within, may equally be longer prevented from going out through the medium of such an envelope, than without it.

That electricity combining and productive of cold from without only by keeping bodies vegetable and animal so compressed and condensed, as to keep later electricity from without of a decombining sort and productive of heat, incapable of penetrating into them, prevents them even when life has quitted them, from putrifying, appears since the moment they are again by heat so expanded as to thaw, they begin to putrify; unless that expansion should be so rapid and so great, as by combustion, explosion, of attraction, again to dissolve them instantaneously, and not to leave time for the more gradual process of putrefaction.

That only as [illegible] of the forces of gravitation and of electricity later portions are made to combine earlier portions in ways different from each other, they are made to combine these earlier portions in substances radiant, gaseous, liquid and solid, different in their nature from each other, appears since all substances are alike formed by electricity, and as each different substance appears [illegible] finally to present forces of electricity, modified and moving in quantities and directions different from the others.

That forces of electricity distant from each other, driven in molecules of substances so as to compress and interlock those substances, may produce alkalies, and that forces of electricity [illegible] in amidst molecules of substances so driven out as partly again to press and drive these substances outward, may produce acids, may perhaps be inferred from the nature, astringent and contracting, of alkalies, and from the nature, dilating, decomposing and producing effervescence, of acids.

That only forces of electricity of a combining sort, by finding in substances of different descriptions a resistance to them in different directions, causes these substances to be compressed in molecules of different shapes, appears since of different substances the molecules, when combined together in larger bodies of a crystalline sort, produce bodies which, when composed of the same sort of substance, in their intrinsic shape, their external relative position, their interstices and their parietes, are always similar, and which, when on the contrary composed of sorts of substances different from each other, in their intrinsic shape and their external relative position, their interstices and their solids—in their collective forms in short—are always different.

That only by the compression of electricity, substances, first radiant and volatile, are rendered successively gaseous, liquid and solid or stationary, appears since in each of those successive later shapes, each portion of a peculiar substance, or each molecule, is driven to each neighbouring molecule more forcibly, closely, definitely and permanently.

That all collective aggregates of substances, from those still gaseous to those most cohering and solid, whether they only be destined to remain to the last inorganic, or whether they be calculated by degrees to become organic, are, from the peculiar shapes of their peculiar component molecules, first made in their condensation and cohesion into larger cohering solids to present a porous and cellular form, only composing a stratum, or layer, or follicle, or membrane extended in a flat and horizontal direction, before this stratum is again by further pressure on its centre made to curve up at its extremities into the form of a cylinder or tube called vessel, appears since the gravitation centripetal and centrifugal acting from opposite sides on that electricity, by which this horizontal form is first produced and consolidated, must by their different opposite pressures subsequently give its productions that curve and converging; and since we see vascular concretions of all sorts only arise later and more partially out of earlier and more general prior horizontal cellular ones. Witness those arising in the cotyledon and egg.

That only, of bodies partly solid, at first inorganic, lifeless and unchanged, by certain new fluids from without penetrating and consolidating within their interstices, without wholly, by their later consolidation and swell, destroying the former consolidation, is first produced and date with them, but again issuing from them, or in them only remaining in their fluid state, or, if in them consolidating, only doing so at their expense, and in doing so dissolve and decombine these former solids themselves, and from the latter being so consolidated as to admit in them of fresh consolidations which destroy not wholly the prior ones, appears since only where substances become organic and living such new consolidations are superstructed within the former solids, as only extend and stretch, without wholly destroying, these former ones themselves.

That external forces and substances, such as cold and heat, air, moisture, and others, in quantities in which from without they penetrate unimpeded in bodies inorganic and lifeless, and either pass through them unarrested, or choke them up, or by their congelation so distend as to dissolve them, and as not to increase by their accession the size or faculties of these solid bodies, are by bodies organic and living, from the earliest and simplest, so resisted as with these to be combined in new quantities, fitted to increase their forms and to extend their faculties, and not to have by cessation of movement or of cohesion their life terminated: that if a body endowed with life can, through its greater heat from within, resist a cold from without, which, in one not living, by congealing every fluid, stops all internal circulation; or can through its greater cold from within resist a heat from without, which, in one not living, by dissolving every solid, stops all internal circulation; that the electricity confined in a seed, an ovum, or any place deprived of thorough draft, resists alike that electricity from without which would in a place more exposed have caused either its further expansion or its extinction; that if in a live stomach the gastric juice exsuding from within, which would entirely have dissolved external bodies taken into that stomach, or have dissolved that stomach itself for want of such substances to protect it, after death has no power over these substances during life, and cannot kill any fruit or leaves wholly uninjured and intact harboured in that stomach; that if in a body, while living, the blood continues liquid and circulating, and in a dying body coagulates and stands still; that if by a body living, hale, and strong, influences and miasmata from abroad are resisted which overcome one in ill health, these are phenomena only arising from the faculty of life; only consisting in the solids of bodies being so disposed, with regard to the intervening pores, as, while suffering the penetration of new fluids in the quantities necessary to make these solids grow, to prevent their penetration in the quantities calculated to decombine and dissolve them, appears since, the moment by death solids are prevented from any longer arresting the entrance of fluids in detrimental quantities, those that present themselves do enter in such injurious quantities as to take full possession of the body, and, finding it deprived of its ægis, from all sides to hasten its decomposition.

That of blood the molecules, which in a live body remain detached and fluid, in a body dying are left from the departure of the heat that kept them separate to coagulate and cohere, appears since if that body, struck by lightning, die of an excess of the electricity which produces heat, the blood will not in it coagulate.

That in organic and living bodies glands are only a tissue of parenchyma or cellular concretions, by prior fluids aggregated in such a way that later fluids of the same sort, driven to and made to enter them, are made in them to give off certain of their component elements, before the remainder are again through vessels formed of part of this parenchyma left to flow out, appears since fluids are seen when running into glands, to be composed of elements different from those of which they are composed when again running out of them.

That only out of a stratum of cellular organs curving till their extremities again join in a cylinder arise vascular organs, appears since vascular organs always arise out of prior mere cellular organs, and first begin to grow in grooves before they end in complete cylinders.

[illegible] in which, [illegible] cellular [illegible] systems of [illegible] and vascular, each [illegible] the other [illegible] one part of [illegible] till pressed by [illegible] descending from [illegible] fluids being [illegible] and mixing [illegible] earth, appears [illegible] determinations [illegible] solids arise out [illegible]: and since [illegible] of the op- [illegible] reversed, in [illegible] faced the [illegible] those which first [illegible] heavens, foliage will [illegible] from where before roots [illegible] and roots will protrude downwards from where before leaves shot forth upwards: and if it should be observed that the new roots and new leaves do not always rise in a straight line with regard to each other—new roots under former roots and new leaves over former leaves,—this must be owing to that obliquity which the shape, extension and spread of their component molecules, when solidified, gives them.

Fix seeds on a wheel so that, by its rotation, their opposite sides shall each in turns face gravitation centripetal and centrifugal, and the leaves and roots both will be disturbed in their natural position, and puzzled which way to shoot forth.

That in organic and living bodies like vegetables it is only by fluids of the same sort, determined in the same direction, being from without arrested by and mixed with the same elements, that are made to arise on them and to cohere with them, new organs of the same sort—new leaves on former leaves and new roots in continuation of former roots—and that in organic and living bodies like animals it is only by fluids of the same sort, determined in the same direction, being from without arrested by and mixed with elements, different in their nature or in their proportions, that are made on former organs to arise and to cohere with them new organs of a different sort—organs sensitive on organs merely vital; and organs intellectual on organs merely sensitive, appears since in new organs of the same description superstructed on former ones, the elements from both sides still are of the same sort and in the same proportion, and since in new organs of different descriptions superstructed on former ones, the elements supplied from without always are different, or at least in different proportions.

That in animals only out of the meeting of earlier lymph and chyle from without in different parts within arises the first blood, appears since in an incubated egg only on points distant from each other that blood first arises, and first partly consolidates in cells, and these cells first are aggregated in flat layers, strata or follicles, before they are next bent in grooves, and before these grooves again, by their extremities laterally returning to each other and joining, become complete cylinders or tubes, and before these cylinders or tubes endwise join and run into one.

That of blood the first sort, that which is formed immediately out of the mixture of lymph and chyle, is veinous: that veinous blood, and veins themselves, precede and are the foundation of arterial blood and arteries: that only out of the later emission of part of the carbon mixed in veinous blood into air, and introsusception of part of the oxygen mixed in air, by what remains of the veinous blood, are formed arterial take in some new elements, themselves been formed there. But that the blood arterial descending, in certain places again remixes with the veinous blood ascending, appears since even in the highest of animals the distinction between blood veinous and arterial is not from the first in the lungs rendered so complete, that there exists not between the two sorts of blood in the hearts veinous and arterial a communication, which afterwards is by the growth and extension of the heart's ventricles closed up, and leaves the two sorts of blood thenceforth throughout to flow entirely separate from each other.

That of the carbon by the lymph poured into the blood a part, again by obstructions in the body separated from that blood, composes the bile and solidifies in the liver, appears since blood is found to carry this carbon into the liver, and since out of that liver again flows separately one way the excess of that carbon in the shape of blood, and another way the residue of that blood, which forms and loses itself in the spleen: and since, as on the one hand animals acquire downwards greater livers, they on the other hand form upwards smaller lungs, and vice versâ.

That the lungs in the later parts proper of an animal formed, are not the only and first organ in which veinous blood is partly made to revert to air, and to be changed into arterial blood, appears since already in the cotyledon or placenta of higher animals itself, through certain earlier [illegible] [illegible] veinous blood is changed into arterial blood, which afterwards through the [illegible] [illegible] is made to pass into the parts [illegible] of the animal, and there to form the [illegible] parts of an [illegible] nature, while yet the lungs, [illegible] in liquid, enter not fully upon their functions; and since during that period there remains between the veinous and arterial hearts, already formed, a communication more direct, which, when, by the opening of the lungs, the formation of arterial blood is circuitously more increased, is by the expansion and growth of these hearts again closed.

That as from the stomach and lungs are, by gravitation centrifugal and diverging from the earth, made to grow upwards the throat and mouth and face and head, from that same stomach and lungs are, by the result of that centrifugal gravitation in an opposite direction centripetal and converging to the earth, made to grow down-for re-ejection, begun in the stomach, appears since, where this bile is not formed in sufficient quantities, the digestion goes on badly, and the body remains costive; whereas, when too much of this bile is formed and sent downwards, the body becomes relaxed.

That only where in an animal aggregate tracheæ had first appeared, a further elongation of these tracheæ outward produced broncheæ, and that only where broncheæ had first appeared, a still further elongation of them outwards causes the internal parts to be called lungs, and that in fishes and in birds it is the pressure of aerial elements from without, or suction of these elements from within, continued still further, which causes that air again to circulate outward till in the fish it forms an air bladder, and till in the bird it inflates the bones and the quills, appears by the relative order in time and in place in which, in successive stages of the formation of animal embrios, these different parts appear.

That far from hearts first causing in the veins or arteries the pulsation, and still less the circulation they manifest, the pulsation, was by the pressure of air from around already begun prior to the existence of hearts: that hearts only through their medium strengthen and increase these former pressures, appears since even vegetables, and animals having no hearts, such as insects, have a certain pulsation as well as motion of saps, and since even human beings have [illegible] [illegible] [illegible] [illegible] [illegible], without being left [illegible] [illegible] [illegible] [illegible].

[illegible] [illegible] [illegible] [illegible] [illegible], in addition to an external [illegible], there is formed an internal surface [illegible] [illegible]. This latter is only a reduplication of the former; that only the different situation of each respecting external space and elements causes the difference of their functions, appears [illegible] in the [illegible], in which the form of the other parts still permits the turning of the two opposite surfaces [illegible] [illegible] out, and the [illegible] [illegible] [illegible] they then exchange offices.

That [illegible] [illegible] [illegible] the inside cavity which [illegible] [illegible] [illegible] [illegible] arises not from a pressure which [illegible] [illegible], and, as it were, digs into the [illegible] [illegible] longitudinally, but from a pressure which [illegible] that mass, first stretched out like a leaf with two corresponding lobes, then again [illegible] itself so as to make the edges of both sides, previously diverging from each other, [illegible] again converge to each other, meet, [illegible], and form an external tube over an internal alimentary canal, appears since in the higher animals is seen to the last, from the top of the head, between the two opposite halves of the forehead, the nose, lips, palate, chin, throat, thorax, abdomen and private parts unto the perinæum, to run a suture, which in some individuals in the regions of the lips, palate and private parts, remains ever incomplete and unclosed.

That in all animals which remain not mere zoophytes, and in which to the external surface is added a secondary internal surface, forming the cavity of the stomach, and that of the broncheæ or lungs, the former external surface is still in its formation the first, and the foundation of the latter:—that the latter hollows are only supplementary to, and only further extensions inward of the former surface, produced by the pressure of external air and elements on the incipient body, appears since even after an animal has issued from the ovum and has come in full contact with external air, not only the stomach but these lungs may still for a time be prevented from inhaling from that air, by the process of breathing, elements more copious, without the animal incurring from this suspension of the fuller nutrition it has become capable of receiving, any other effect than that of the sensitive faculties, which depend upon the more copious influx of those elements from air, not yet attaining their maturity: and since, when cold or other circumstances from without, cause any obstruction the lymph or chyle that are made to enter through the external pores of the body, this obstruction, in its turn causing an alteration in the exsudations flowing out through the internal pores of the stomach, in the shape of gastric juice, and in the internal pores of the lungs in the shape of carbon, impairs the functions of the whole of the gastric and pulmonic systems.

That in entities organic and living, of elements from without, the influx, circulation, nutrition, change, renovation, deperdition and exit, which is first and most fundamental, and exists where none other exists, and, where any other appears, precedes and causes that other, is that which is carried on through the external pores at the surface of the body; that all influx of elements aerial from without, through tracheæ, broncheæ, lungs and other organs, which again to veinous blood adds more arterial blood, and all influx of elements aqueous from without, through stomach and bowels, which again to prior chyle adds new chyle more copious and more substantial, is later and secondary, and founded in part on the first, by elements from without, on the solid parts of animals more elastic pressing deeper inward, and forming in them as it were greater dents, before they are with the fluid issuing from these dents again mixed in new fluids pressing inwards, appears since in all vegetables and in some animals there is an external inhalation and exhalation, both aerial and aqueous, where there are not yet either broncheæ or stomach, while, where there are the latter, these are always preceded by and composed of part of the same elements with the former.

That in animal formations, after the ovum or placenta, the parts within these parts more external and fundamental, called abdominal—namely, those which from that placenta sprout first inward into the parts gastric, pulmonic and hepatic,—are the earliest and most fundamental, appears since, on the foundation of the placenta, these are through the umbilical vessels or cord first within it formed, and since only later on these again arise the muscular envelops that, withinside the placenta, again enclose them, and only out of these prior parts gastric, pulmonic and hepatic are again made to arise, to grow and to elongate upwards, those ducts or spiracula or tracheæ of an anterior sort that end in the orifices of mouth, nose, ears and eyes, and downward those other ducts, spiracula or tracheæ of a posterior sort that end in the orifices of the bowels and excretory ducts, and finally laterally those still different ducts of a transverse description anterior and posterior that end into extremities or limbs again later closed up and becoming solid; and since to the last from the parietes of all these parts, even those like fingers and feet, afterwards closed up, still continue to exsude a peculiar mucus or fluid, in the lungs and mouth called saliva, in the stomach called gastric juice, in the nostrils called nasal mucus, in the ears called wax, in the eyes called lacrymal fluid, even between the fingers and toes only called by the more indefinite name of perspiration, similar to [illegible] from which [illegible] first in part [illegible] exuded [illegible] from without, on [illegible] merely vital, [illegible]

[illegible] still con- [illegible] the parts proper [illegible] already absorb [illegible] only at the [illegible] pores of the [illegible] either later [illegible] super- [illegible] before the [illegible] partly by ele- [illegible] from the lungs [illegible] those parts [illegible] from without [illegible] but only are [illegible] disengaging [illegible] is first launched [illegible]

[illegible] in short, in certain streams of fluids from the earlier, more inward, and more fundamental parts proper of the animal body driven outward in surrounding air, being at their exit from the body, in part by new elements from without rushing in, stopped, and with these combined in new organs, serving as spiracula to the fluids going out, and as tracheæ to those coming in, begin not only all the later and more external organs of mere vitality, such as stomach and lungs, but all those of sensation, of intellect and of voluntary reaction outward—all the features of the face, all the organs of the brain, and all the limbs of the body—that of all these the commencement is found in certain spiracula and tracheæ, through which certain fluids, from within driven out, are by new aerial elements from without penetrating inwards arrested and made with these to form new recombinations, appears since not only the mere tracheæ, broncheæ and lungs, through the medium of which blood arterial is converted into blood veinous, arise in this way, but since all the organs sensitive, cerebral and of voluntary action—from the tentacula of asterias and medusas, and the proboscis, antennæ, eyes, and even wings and legs of insects, to the mouth, nose, ears and eyes, and organs of thought in the brain, and arms and legs issuing from the body, of higher animals,—begin in spiracula, tracheæ, tubes, cavities and ventricles, from without letting in air and aerial elements and influxes, and from within letting out vital exsudations and effluxes, which there meet, and by the pressure from without are partly consolidated into new organs, and partly, through these new organs, in their fluid state, made to re-enter the system;—this process even being visible at first in those limbs and extremities, which afterwards, by such ingoing fluids from within and from without meeting and consolidating, become by degrees entirely curdled up and solid.

That where in animals of a more complex sort, at a later period of their development, their bronchiae, first at their origin wider and shallower, are elongated outward, and in their elongation are contracted into a longer and narrower tube, called eustachian tube, before they end in the orifice of the ear, and force the air and carbon from within, which even in fishes still is emitted through these bronchiae, to be in beasts, in birds and in man forced out through those other outlets, at first only destined for the stomach, of throat, mouth and nostrils, appears since to the last there remains a communication of the lungs, through the eustachian tube, with the ears; since when the functions of the lungs are disturbed, those of the ear are often so likewise, and since when sounds from without are through the oriwhole substance and form again, by the preponderance of surrounding parts so reabsorbed and sucked in as to disappear, is evident in the tail of a tadpole, which by degrees, as the hind legs grow and elongate, has its elements again by these legs reabsorbed; and even in the tail of man, which first, in the fœtus, very visible, is again, long before that fœtus takes its last distinct shape, in the same way again reabsorbed, and made to contribute to the growth of the hind quarters.

That, as in vegetables between the glands formed one way, called roots, and formed the other way, called leaves, the intervening stalks and stems only later proceed from the elongation of the vessels upwards, which from the earlier roots ascend to the later and higher leaves, and downwards, which from the earlier leaves descend to the later and lower leaves, so in animals, which by degrees longitudinally one way, between their body and their head, and the other way, between that body and their tail, and moreover latitudinally, between that body and their lateral extremities, have intervening parts elongated in neckings very long, very slender, and very contrasted with the expansion and swell of the ultimate parts to which these neckings lead; such as are shown by certain insects—wasps, dragon flies and spiders,—and even by certain beasts and birds—antelopes and giraffas, swans and storks—these neckings, are partly by the pressure from the body elongating outward, and partly by the counterpressure from the extremities elongating in the same proportion inward, formed and made to grow, and are only increased in proportion to the more aerial nature of the fluid in which these animals are first formed, and which they continue to take in, appears, since these neckings, wherever they are produced, only are produced and made to grow one way, outward, out of the organs that support them, and the other way, inward, out of the extremities which they themselves remain attached to; since in animals as in vegetables the extreme parts themselves—in one the leaves and roots, in the other the features and limbs—make their appearance and protrude from the body, prior to those intervening neckings; since in animals of an aquatic sort, such as fishes, these intervening neckings never appear; since in those which from aquatic become aerial, it is only after they have become aerial that these neckings appear; and since in human beings, in which early in their fœtal state the brain has slipped out of the head, and remained huddled in a bag behind it, for want of the usual counterpressure from the head downward, the neck never acquires its proper length.

That where a limb is lost, and is not by the later fluids from the body flowing out replaced, it is only because these fluids are absorbed by the neighbouring organs, appears since by this loss these neighbouring parts are the gainers, and thrive and increase upon the superfluous fluids which the lost limb leaves unemployed.

Having thus made all the essential observations that occurred to me respecting the substructure and scaffolding of parts merely vital, on which in animals were superstructed the later parts sentient, thinking, and voluntarily acting, I shall now pass over to these latter.

CHAPTER XX.

Sensation.

I now pass over to that attribute in animals, without the addition of which all the former attributes thus far described in them would have been to their owners of no avail: without which, to crown them, all the former ones might as well not have existed; to that attribute which seems indeed to have been the only object of all the former ones:—the only attribute that stamps on the former ones all their value; that through which alone the former ones, which add not themselves this latter attribute to the others they have, can be known, be appreciated; of which the former ones seem only, where this latter sort exists, to have been the prior foundation, base, ground-work and scaffolding; without which the former ones could not even have been described or known;—since in fact we only know, only can describe insentient entities, in the way in which they are by our sensations represented to us. I mean the attribute of sensation itself.

The word sensation means a feeling, a consciousness of a thing which may itself exist, independent of and prior to that feeling or consciousness of its existence.

What the other words by which I explain its meaning—namely, those of feeling and of consciousness—are intended to express, I must appeal to the understanding of my reader for comprehending, without any further comment or explanation on my part. These words are the audible signs for phenomena which occur so constantly, and concerning which human beings so constantly communicate with each other, that their meaning can scarcely be liable to misconstruction. At any rate I cannot substitute to them any other words more notorious, more familiar. Any attempt to define them by other terms would only render my explanation more circuitous, without rendering it more clear.

All I can attempt to define is the extent of the phenomena that partake of the nature, and ought to participate in the name of sensations; and in doing so I shall show that this extent is much greater than it generally is supposed to be; that, though all sensations are not yet such as are called ideas, all ideas still partake of the nature of sensations; that, in order to be consistent in our application of the word sensations—to continue giving it, wherever we continue to find the conditions to which it was first applied—we ought to give it to all ideas of the mind, as well as to all feelings of the body.

The word sensations is first applied to the feelings, the consciousness of events and entities withoutside our own individual, of which we receive in that individual a feeling or consciousness. Among which are first those of time, space, quantity, proportion, divisibility and number, received to a certain degree by each of the five senses alike, and next those of touch, taste, smell, hearing and sight, each only received by one of these five senses, to the exclusion of the rest.

The word sensation is likewise, or at least ought, by the same rule by which it is applied to these feelings and consciousnesses, coming directly from objects without, to be applied to all later repetitions of them, which, after the external objects themselves, first causing these sensations, have ceased to impress us, still continue later in our individuals to arise out of them under the name of ideas, or thoughts, from those primary thoughts merely called recollections of prior actual sensations, to every other sort of thoughts most abstract and most recondite, which in their turn are the later offspring of these have a common origin with sensations of the body, and still often call them by the more generic and primitive name of sensations. We say that people are subject to very strong sensations of peculiar impressions—of joy, of grief, of ridicule, of ennui and others;—but in general we are wont to regard ideas in the mind as having an origin, a nature wholly different from those of the sensations experienced by the body. Of this opinion, however, I shall presently show the error.

We shall here only first discuss the sensations of the body.

We deem all these to be effects, nay, representations of certain events and entities, more early and external than themselves, which precede and which surround their locality,—of certain external modifications, from those of mere time and space, to all others more partial, again included in these, which we experience; and deem them caused by the impressions which these events, entities and modifications make upon us.

Thus we deem certain modifications to exist withoutside us, which give us the impression of time, of space, of force, of pressure, of movement, of substance, of tangible form, of radiance, of gaseousness, of liquidity, of solidity, of cold, of heat, of savour, of odour, of sound, of light, of colour, of form and motion visible to the sight, and of the other attributes from without, of which we are conscious; but this belief is only a later [illegible] [illegible] [illegible] [illegible] [illegible] and modifications. Those of time and space themselves consequently [illegible] [illegible] external time and space; and these [illegible] in the sensations of time and space, [illegible] the earlier and more [illegible] [illegible] [illegible] in the [illegible] of time and space. Those sensations that come from similar external attributes and impressions always come in a similar shape, and those that come from external attributes and impressions of a dissimilar sort always come in a dissimilar shape. These sensations are more complex and more [illegible] than those of mere time and space, which necessarily come included in certain of those of time and place themselves, always immediately following and immediately included in that external time and place, and in the other external attributes again included in those of time and space themselves. In the sensations of time and space present in order exactly following and simplest and the most general word that can be used for the phenomenon to which it is applied, when that phenomenon is regarded in itself, and without any reference to whence it derives or to what it represents.

How it happens that certain modifications, to certain entities withoutside them do not give a sensation of their existence, of their differences from other modifications; and that to certain other entities withoutside them these modifications do give such sensations; what other modifications earlier and simpler than those of which we receive sensations there still may exist, of which none of us yet receive any sensations, and which none of us yet know, yet suspect, are still secrets of nature, by the first cause withheld from our cognizance, and concealed among the earliest unknown attributes of matter. We must thus far rest satisfied with knowing that certain sensations do arise; and with believing that the cause of certain of these sensations arises out of that of certain others; because we always see them, where they exist, only follow those others; because we only find them, where preceded by those others.

All sensations of the external sense are moreover supposed to be the effect of, and to come directly from, the impressions of certain earlier and more distant external objects and modifications;. to be analogous to the intrinsic nature and attributes of the objects from which they come; to represent these objects and modifications. Those of time and space themselves consequently represent earlier external time and space; and those situated in the sensations of time and space, represent the earlier and more external attributes situated in the attributes of time and space. Those sensations that come from similar external attributes and impressions always come in a similar shape, and those that come from external attributes and impressions of a dissimilar sort, always come in a dissimilar shape. Those sensations later, more complex and more partial than those of mere time and space, which necessarily come included in certain of those of time and place themselves, always immediately following and immediately included in that external time and place, and in the other external attributes again included in those of time and space themselves, in the sensations of time and space present an order exactly following and tallying with the order in time and place offered by the real external objects and modifications, whence they directly and without any circuit proceed.

That by the will of Providence sensations only arise in certain peculiar organic forms, composed of certain peculiar elements, may be inferred from sensations only existing where have been matured those peculiar organic forms, arising out of these peculiar elements.

That of those peculiar elements nitrogen seems the first and most indispensable, may be presumed from such organic entities only as receive in their first composition a certain quantity of nitrogen becoming animals, i. e. entities capable of sensation.

It is probable that nitrogen, mixed in certain proportions with the other elements required to render entities organic, gives them that elasticity, which is necessary afterwards to enable them to admit the later influxes, upon the reception and combination of which sensation depends; and to receive from these the peculiar impressions, in the consciousness of which that sensation resides.

As entities have in their first composition more nitrogen, and as that nitrogen enters more considerably in the first composition of certain of those parts, they afterwards acquire faculties of sensation more extensive and more developed.

It is through these sensations that we are made first to believe in the existence withoutside them of certain means, certain modifications, certain objects, different and distinct from each other, some only giving the impressions that cause the sensations, others also receiving such sensations. That, for instance, we believe in the existence of a stone, a vegetable, an inanimate entity, still unable to receive a sensation, being able to give to an animated entity a sensation; and in the existence of an animated entity being both able to receive a sensation from that inanimate entity—that stone, that vegetable,—and able to give a sensation to another different animated entity.

It is through means of certain sensations being so much more permanent than others, that we accustom ourselves to regard certain of these sensations as proceeding more directly from the impressions of a body of our own—from what we call our own individual; and that we regard certain others, more transient, as only, through the medium of that body of ours, received from objects more distant and more shifting.

In what we thus regard as a body of our own, we so often, in certain parts different from others, receive from the same external objects sensations so different, and from objects very different sensations so similar, that we at last regard certain parts, certain organs, as only fitted to receive certain peculiar sorts of sensations, and not others; and these organs we call organs of peculiar senses. We begin to believe that peculiar sensations do not depend solely on the objects by which they are given, but also on the organs, the instruments, by which they are received:—on the peculiar manner in which these instruments alone can be affected by these impressions.

Men very often are heard to say, that they have received a sensation from an object in time and space, still distant from them; that they have seen a star twinkle in the firmament; heard a gun fired many miles off; the warmth of the sun; the coolness of the moon. But this mode of speech, in its absolute sense, is only a *façon de parler*. The first cause of every sensation may indeed be as early as the beginning of time, as distant as the outskirts of space; but the cause that immediately produces the sensation, whatever object it more distantly comes from, must be in immediate contact with the organ in which its sensation arises, ere the sensation actually arises. It can no longer be in the object from which it is said to come, if that object be distant from the said organ in time or place. It is only after of a star the light has traversed the whole intermediate space which separates the firmament from the human eye, that in that eye there can of that light arise a sensation: it is only, after of a gun fired off, the vibration has advanced till it reaches the ear, that that ear can hear the report; we do not feel the warmth of the sun, the coolness of the moon, till long after these forces have quitted those bodies, and, athwart intervening space, have reached, and have penetrated in our pores.

As of the sensations which we receive there are certain sorts, such as those of time, space, quantity, proportion and number, which we can receive without receiving any others, while we cannot receive certain others, without their being included in certain of these first, we must suppose them to be the first and most general which any organs of sense are rendered capable of feeling; and it therefore is with the faculty of feeling these that we shall begin our investigation of the faculties of sense.

CHAPTER XI.

[illegible] of animals depend [illegible] of the organs of [illegible] certain periods, [illegible] certain sensations

[illegible] in general [illegible] and familiarly [illegible] higher vegetables [illegible] than by the [illegible] more strikingly [illegible] vegetables, taking greater [illegible] ones, which [illegible] vegetables, and in these higher animals observing the higher attributes, these, before he notices and discerns the more early and fundamental resemblances which animals still retain to vegetables. If by accident he stumbles upon animals which, like zoophytes, have few of the later differences that again distinguish animals, superstructed upon the earlier resemblances which still assimilate them to mere vegetables, he is apt to regard these animals more as exceptions to all rule, as deviations from all regular series, than as the earliest specimens of a new species; as the intermediate link which connect the last of the mere vegetable class and the beginning of the animal genus. Thus it is that he begins by still considering the mere vegetable genus and that of animal as separated by an immense interval.

But by degrees, when he happens more minutely to consider such entities as that bothryllus which still, from the general inorganic base of the earth only, like a mere vegetable, shoots forth stalks in indefinite numbers; as that pyrosoma, of which the different stems still from their base to their summit remain connected, by certain vessels which adhere to each in turns, and only successively pass from the one to the other; as that zoophyte which resembles a plant terminating in a flower; or that polypus which resembles a flower only, which bears the very name of sea-anemone, which still suffers itself to be engrafted on other individuals of the sort, or to have its own stool and petals again divided from each other, and each part again, like the fragments of a poplar tree, is made to reproduce the other parts wanting, and singly to rebecome a perfect polypus;—and when he nevertheless in those entities, still so like mere vegetables, recognizes faculties of sensation which only belong to animals, he begins to waver; he thinks that, between the mere insentient organization of vegetables and the sentient organization of animals, the line is less distinctly drawn, the transition is more gradual; that as the former sort of organization is the necessary foundation of the latter, out of certain developments of that former, the latter arises more certainly. He then asks himself, what are the conditions by means of which, out of mere organization, arises the power of feeling?

He finds that the power of feeling does not depend upon entities having a general form visibly different from that of mere vegetables; for mere zoophytes have not such a form, have only, like vegetables, an absorption of elements aerial and aqueous, directly from without; have not any internal lungs or stomach, any internal cavity, through which passes either more aerial or more aqueous food, before it enters the system; —and yet they feel.

He only finds that they depend for the faculty of feeling on having superstructed on the organs of mere vegetables, which are not sentient, certain other organs which indeed can only be superstructed on the former ones, and which are sentient, but which are so minute that they remain imperceptible, and do not materially alter the form, disposition and appearance of the former ones themselves. He finds that these new sentient organs can be superstructed on the prior insentient ones only, where these prior insentient ones themselves already possess certain qualities, which the insentient organs of mere vegetables do not possess; since there is no reason why, if they did possess them, they should not, in time and by degrees, from mere vegetables all grow into animals.

Now what are these qualities, these conditions, which the organs of mere vegetables do not possess, and which alone can qualify those entities that do possess them to become animals?

They are not merely the being composed of time, space, electricity, gravitation, light, colour, oxygen, hydrogen, nitrogen. All these elements are already, in a certain degree, necessary to certain mere vegetables. Though animals are considered as having more nitrogen than vegetables, among vegetables the acrid cruciform already has a quantity of nitrogen approaching to that of animals.

Yet of that nitrogen a greater quantity than is found in any vegetable is found in all animals; and this nitrogen, therefore, though not yet probably itself directly forming the sentient organs of animals, already itself, where in greater quantity, gives the insentient organs of animals that superior elasticity necessary to admit the greater quantity of other elements, not yet admitted in the composition of the organs of vegetables, destined to remain such only, which is necessary for affording room to construct in other entities, destined to become animals, the organs necessary to receive sensation.

Nitrogen does not probably immediately produce powers of sensation; but when in certain proportions it produces in insentient organs the capability of superstructing on these the other later organs, which, when consolidated, matured, and put in the situation necessary for the purpose, receive powers of sensation.

Now what in sentient entities again are the elements; what is the fluid—of which in certain entities, certain proportions, when consolidated, when matured, when put in the situation necessary for the purpose, actually receive these powers of sensation?

In order to ascertain, to investigate this, I must begin by ascertaining, by investigating, where are first seen the organs that acquire those powers of sensation, and from the meeting of what fluids, what elements, they can first be supposed to arise; and in order to do so, I shall be obliged to expose, in reference to the first locality and origin of these organs, some errors which still lie in my way and obstruct my progress.

Most people taking their idea of the first locality and origin of all organs of sensation only from those of higher and more complex sentient entities, in which again they see them further removed inward, fancy that in all animals these organs have their first origin in the interior parts of the frame, nay of the head, and thence proceed, in the shape of nerves, to the more external parts of that frame.

But it is contrary to analogy that the first causes of sensation should arise from without, and that the first vehicle of those sensations should, instead of likewise arising from without, first arise from within; that they should have a course opposite to their cause. This would be the contrary to what takes place in all other channels conveying the causes of certain effects from one place to another; all these begin from the same point from whence begins the flow of the elements which they convey, and by which they are first caused.

It is also contrary to observation—to experience. We find animals not yet endowed with heads, not even endowed with nerves, which already offer [illegible] organs of sensation. Consequently in [illegible] of sensation cannot [illegible] cannot be nerves.

I therefore believe, that of faculties of sensation the first origin arises in organs of which the roots are situated directly under the pores of the external surface or epidermis, through which first from without come the immediate causes of the sensation itself, and directly over the muscle further inward, on which arise the first causes of that sensation. That these roots of the organs of sensation, there individually consisting in mere glands or papillæ of excessive minuteness, there collectively form the tissue called dermis, which, in inferior animals, where the papillæ of sense are only at great distances diffused in very small numbers, is very thin and difficult to discern; but which in higher animals, where a greater number of these organs are more approximated, becomes a dense tissue, notwithstanding in these higher animals only the first half or roots of organs of sensation remain near the external surface—notwithstanding in these higher animals ducts roots in foci more condensed, called ganglia or brains, and carrying to these the influxes and impressions from without, before in these is from them received an actual sensation. I believe the general dermis to perform to the sense of feel the office which the retina of the eye performs to the sense of sight in particular.

If so, like all faculties, all instruments of sensation first commence from without.

Now it appears, that even from without, in an animal, neither in the mere lymph formed by the remixture of part of the first and most fundamental saps with new aerial elements descending from on high, nor in the mere chyle formed by the remixture of another part of the same first and most fundamental saps with the aqueous elements ascending from underneath—and which two fluids only in animals hold the place, which in vegetables hold the descending and ascending saps—when consolidating, yet acquire the faculty of immediately receiving sensations, since neither the solid parts internal, nor the solid parts external, formed of mere lymph or chyle, yet receive sensation; since neither internally the serous membrane that surrounds the viscera, nor the periosteum of the bone, nor externally the epidermis, the rete mucosum, the nails, hair, bristles, wool, feathers and other substances, formed of mere lymph or chyle, while still unmixed with parts formed of blood and blood-vessels, yet acquire the least power of sensation;

as we perceive when we cut our nails, and curl our hair.

But when lymph and chyle again are remixed in blood, even merely veinous, and when this blood is again from within driven outwards, and with fresh elements from without flowing inwards remixed, is again driven inwards, then, as soon as the parts in which it consolidates are sufficiently matured and in the proper situation, it appears to acquire powers of conveying sensation.

In animals in whom we still only find veinous blood, we already find such powers of sensation; and in animals who to veinous blood add arterial blood, we only find this blood produce organs of sensation more exquisitely sensitive.

Even the parts internal and external, fundamentally only composed of lymph or chyle, and fundamentally insensitive, when by lesion or disease they are made penetrable to blood from within, and to aerial elements from without, out [illegible] blood from within, and on the other side of aerial particles from without, that first arises in animals the fluid called nervous, which composes organs of sensation; and the external muscle is the chief soil in which these opposite fluids have, by reuniting and remixing, the opportunity of forming and of consolidating together in the glands, requisite for the purpose of receiving from without and conveying inwards the impressions that cause sensation.

In fact, as in entities the blood from within remains less exposed to remixtures with elements from without, the sensibility is less. In people long bedridden, or confined in gaol, or otherwise debarred from free communication with air, sensation becomes blunted, deadened. In people greatly addicted to air and exercise, it becomes more intense, more susceptible both of pleasure and of pain very vivid.

What proves that the elasticity sufficient to produce organized entities unendowed with organs of sensation, was not yet sufficient to produce entities able on their more insentient organs to superstruct organs of sensation; and that the elasticity sufficient to produce entities able on their insentient organs to superstruct a few organs of sensation, was not yet sufficient to produce entities capable on their first sentient organs to superstruct other organs of sensation higher and more complex, is that on this globe we see, in the remains of former entities a regular gradation and progress not only from the relics of entities inorganic and lifeless to those of entities living without feeling, but from these again to others also sentient; and from those only possessed of organs of sensation few and simple, to those having organs of sensation more expanded, more varied and more complex. The lower strata of undisturbed remains only being composed of the former, and the higher ones only of the latter.

I believe that in sentient entities the blood from within, driven outward, only with elements from without driven inward is mixed and combined into the organs of sense, which, when matured and exposed to fresh influxes from without, are capable of receiving sensations of the same sort of influxes from without, of which they were first composed.

This may at first sight seem a paradox, an absurd belief. A man may have sensations of feel of a peculiar engine, of taste of a peculiar same sorts of simpler elements of nature may already have been composed the organs of the different senses themselves, out of whose combinations were composed the instruments, calculated to perceive the combinations of these different productions of nature in works of human art.

And that this was the case, appears since the different organs of sense thrive, invigorate and increase only upon further influxes of the same peculiar elements from without which they are calculated to perceive, in certain quantities and proportions, and since these organs, like all others, only thrive and increase and invigorate upon elements similar to those of which they were first formed and composed.

All organs of sensation, composed on one side of blood from within, and on the other side of elements from air without, must thus, through the medium of that blood, itself already first formed only out of elements from without, already in part more remotely have been founded out of such elements from without, and must, through the medium of further elements of the same sort, subsequently again taken in from without, in greater quantities and more directly, have by this greater accession of the same elements, been later finished and matured.

All organs of sensation, alike capable of receiving sensations of time and space, and quantity, proportion and number, must, as nobody [illegible] composed of certain portions of time, space, quantity, proportion and number; and to these fundamental elements and attributes. [illegible] the organs of feel in particular must have added portions of those attributes of pressure, of resistance, of cold, of heat, of dryness, of humidity and of all others, by their combination in time and place, producing tangible forms and movements, of which the touch receives a consciousness; those of taste must have added certain portions of those elements of the different flavours of which the taste receives a sensation; those of smell must have added certain portions of those modifications of scent of which the smell acquires a perception; those of hearing must have added certain portions of those modifications of substance and movement—of resistance, of pressure and of vibration—by which the hearing is afterwards struck; and those of sight must have added certain portions of those modifications of light and only be driven to all the different parts of the surface of the body, in small and equal quantities, and on all these alike be, with different elements from without remixed in different minute organs of the different sensations which they experience, so as over the whole body to receive sensations of feel, of taste, of smell, of hearing and of sight; and in fact, we already see zoophytes without distinct mouth, or nose, or ears, or eyes, already affected over a great part of their body by certain modifications not only of feel, but taste, smell, sound and sight.

And it is only in animals later and more complex, endowed with a head and with limbs, that the blood, more peculiarly driven to these extremities, there with new elements from without, on organs first only insentient, forms organs of feel, taste, smell, hearing and sight more separate, more each collected and concentrated, and consequently more each capable of receiving from further influx of the same elements, sensations concentrated, distinct and vivid.

If any doubt could remain that organs of sense are first composed of the very elements, of the further influx of which afterwards, when matured, they become capable of receiving sensations, this doubt must be done away by these organs feeling, in case of a disorganization sufficient to make them lose a certain portion of their component substances, but not sufficient to deprive them entirely of the power of sensation, the same sort of elements, of which they receive the perception, again driven out of them.

We sometimes feel, without any cause for these phenomena in the external world—without any pressure or influx of external forces and substances accountable for the effect; in a state of entire external quiet, silence and darkness, and in consequence only of mere disorganization from within,—of mere decombination and efflux of part of the elements of which they were originally composed,—in the organs of the sense of touch, from within a peculiar degree of cold, or heat, or pressure, or shivering, or irritation, again making its way outward. We feel in the organs of taste, when we are in ill health, disagreeable and mawkish flavours again from the stomach issue outwards; in the organs of smell we find, when unwell, disagreeable fumes again from within, making their escape. Even, when indisposed and nervous, we feel the ears affected by noises, by ringing from within; and after a sound night's rest, during which light and colours may be supposed to have accumulated in the eye, we find these lights and colours, on awaking and unclosing these eyes, again in perfect surrounding obscurity issue from that eye in the shape of scintillations and of sparks; nay we find by blows and by violent pressures these sounds made to be driven out of the ears, and these lights made to be pressed out of the eyes, with greater intensity still.

As only on prior parts vital that are not sentient, can first arise that blood which, in peculiar directions driven out, and arrested by, and mixed with peculiar elements from without driven in, can with these elements from without be recombined in peculiar organs of sense, it is on the elements issuing from the prior vital parts which still are themselves insentient, that must depend what elements from without they can recombine with in organs of sense; what organs of sense can on the vital parts of an animal be constructed, and where these organs of sense can be situated; whether they still may be over the general surface mixed together, or whether they must be separated from each other, and each driven to a peculiar part of the external limbs and orifices; where those of different sorts shall be more separated from each other, and where more of the same sort shall be more combined and concentrated, and made to receive sensations more distinct and more clear.

Already in mere atmospheric air, wherever it offers sufficient resistance, may be formed not only solid bodies inorganic, and solid bodies organic still insentient, but even solid bodies which, to organs only vital, shall again, through the medium of blood, add organs of a sentient sort. Such bodies perhaps we inhale when we are poisoned by mal-aria. In water may arise myriads of other sorts; and on land, between air above and water underneath, may again be formed millions of other sorts, imperceptible to the naked eye.

CHAPTER IX.

Pleasure and pain.

It [illegible] [illegible] been [illegible], for reasons which I shall not here detail, that in animals in organs calculated to receive sensations of any sort, sensations of pain are experienced prior to sensations of pleasure; and consequently, as pain only proceeds from evil, and pleasure from good, evil is antecedent before good. This is not true; it is not analogous to the process of nature. Organs, by meeting of sorts from within and elements from without formed and increased and invigorated and matured till they acquire faculties of sensation, must, as long as this meeting of opposite sorts takes place, in quantities calculated to increase their size and vigour, increase their sensation of pleasure. This circumstance experience shows to be the case in all organs of sense. Whether they only become conscious of mere duration and expansion; whether of force, movement, impulse, resistance, gravitation, electricity, cold, heat, substance or form, or whether of impressions of other modifications of touch, taste, smell, hearing or sight more definite, these sensations, as long as sufficiently moderate to benefit the organs, are grateful and pleasant. It is only when the modifications that cause them, impress or flow in the organs in such quantities, and with such force, as to lose their balance with the blood that flows in them from within, as to overpower that blood and the organs themselves first out of prior similar elements composed, and as again of these organs to promote the decombination—to injure them—that the sensation, before pleasurable, begins to become painful, and increases in painfulness as the injury increases, until by the entire destruction of the organ, the capacity in it of receiving all further sensation, either of pleasure or of pain, ceases altogether.

Where a phenomenon, as yet to us so inexplicable as that of certain influxes from without causing, with a peculiar impression, a sensation of that peculiar impression, takes place, it seems to add but little to its wonder, that, as long as the impression, the influx remain only in such quantities as to be beneficial to the organ, the impression should only remain pleasant, and that, as soon as they become so immoderate as to injure that organ, the impression should also become painful, and that, on the one hand, the benefit arising from an influx from without, in a quantity moderate and proportionate to that of the blood from within, causing the organ to extend and invigorate, should cause it from a mere [illegible] yet harbouring [illegible] any intention of so [illegible] a swell, a pro- [illegible] fresh elements [illegible] from within; [illegible] the injury [illegible] in quan- [illegible] to that of [illegible] organ, on the [illegible] should cause [illegible] sion and a [illegible] repel, and [illegible] without and [illegible] mechanical [illegible] consciousness, [illegible]

[illegible] causes an [illegible] sense to re- [illegible] naturally [illegible] cause which [illegible] an organ [illegible] causes [illegible]

[illegible] and thus [illegible] has thereby [illegible] and [illegible] the swell, [illegible] by the former, or [illegible] shrinking induced by the other, will in the organ leave a sensation of that effect called, no longer in the organs of sense, in their capacity of organs receiving impressions directly from without, sensations of the sense, but called in these same organs of sense, in their capacity of also, in consequence of these prior impressions directly from without, receiving later similar impressions from within, recollections, ideas of the mind; and the same cause which causes in the organ, with this continued swell and orgasm, or depression and shrinking, this recollection of that impression agreeable or disagreeable, will cause the influx from without and the efflux from within which causes the impression to continue being sought, or to begin being shunned.

But as recollections are in an animal the first sensations, no longer called of the sense but of the mind—no longer coming chiefly from without, but chiefly from within—I must here stop and examine whether, as some people think, ideas of the mind are entirely distinct from sensations of the sense, or whether they are the natural and gradual later consequence and development of the external causes of these very sensations themselves.

CHAPTER XXIII.

Mind, intellect, understanding.

What is mind?

It is an aggregate of faculties of which the earliest, most extensive, most fundamental and most simple consists in the capacity of summoning up in the body certain sensations, which proceed not immediately from impressions received from withoutside that body, but may, where such sensations have at any time preceded them, in their absence be still experienced.

It is the faculty, for instance, where we have felt from without certain feels, or seen from without certain sights, of again, without their cause again coming directly from without, experiencing them, no longer continue to flow in;—no matter whether these sensations continue combined together in the more simple sensations of time and place, in which they must be included, in the same order as those prior sensations of impressions that come directly from without, or whether they be combined in these in a new and different order.

Mind shows its existence in sleep as well as awake; in dreams as well as in waking thoughts; in pictures of objects, which in their composition are unlike any sensations of real external objects beheld, as well as in actual representations of such real external objects; in sensations faint as well as in sensations vivid: but whatever be the combination of the materials that form the pictures of the mind, their intrinsic nature, their quality is always the same as that of certain of the sensations, which we have first received from the impressions, by certain external objects made on certain external organs of our individual, first and most fundamentally called sensations of the sense.

There are people who have, between the meaning of the word soul and that of the word mind, made a difference. To have done so, they must have understood by the word soul the general capacity by God given to certain modifications—whether of matter or not of matter—to receive at a certain future period certain sensations or ideas, even before these modifications [illegible] [illegible] received actual present [illegible] [illegible]; and by the word mind, may be meant present possession of that [illegible] and ideas. At least [illegible] [illegible] difference of which the meaning [illegible] words is susceptible. The word sense seems to include the faculty of receiving certain feelings directly from without, as well as certain impressions of these feelings from within; the word mind seems confined to the latter faculty alone.

As I have already observed, the sensations of the mind in their intrinsic nature still wholly resemble those of the external sense. Like the sensations of the external sense, those of the mind are in the first place more generally sensations of time, space, quantity, proportion, number and order, which are necessary to include and support those sensations more pointedly belonging to peculiar senses only to the exclusion of others, and in the second place, are more peculiarly sensations of touch, taste, smell, hearing and sight, necessarily included in and founded upon certain of these former sensations. Oftentimes, while we are asleep, and in dreams in which none of the former sensations interfere with and eclipse the latter, these latter are themselves taken for sensations of the external sense; this even happens while we are indeed awake, but are in that morbid state called of insanity or delirium. When in sleep we receive not through the external organs of sense actual sensations of impressions and objects from without, the sensations arising in the mind, in that case stronger than when we receive any sensations directly coming through the sense from without, are then themselves taken for such, or at least are not distinguished from them, and produce in the mind, and often in the body, the same effects which these would produce; we feel the same internal wills, desires and apprehensions; and often exhibit the same voluntary actions outwards. In general, however, sensations of the mind are less intense than those of the sense; those no longer of mere time and place have, moreover, a capability of being summoned up in those of mere time and place themselves, in an order no longer similar to the only order in which can be received sensations directly through the sense coming from without; which latter must always be experienced in the very same order in time and place, in which external objects and modifications directly produce them.

These phenomena of the mind have, in addition to their primitive, earlier and more generic name of sensations, which to all intents and purposes belongs to them as much as to the sensations of the sense immediately proceeding from without, received the appellations more frequently applied to them of ideas or thoughts. The former word, taken from the Greek verb seeing, properly would only express those sensations of the mind which are derived from the sense of sight; and can only by extension be applied to others; the latter word, taken from the Saxon *thinging*, or thinking, is directly expressive of all sensations or ideas whatever of external things, through whichever of the senses they may be produced in the mind.

I have already said, that many ideas or thoughts of the mind are pictures and representations of the prior sensations of external objects and modifications received through the sense, but reawakened, in the more general ideas and thoughts of mere time and place, in an order totally different from that in which they were first received directly from without; and these ideas and thoughts are called more pointedly imaginations, fancies; and are only recombined in the mind out of and drawn from those prior ones, called recollections, which represent more faithfully and ternal sense, we receive sensations immediately of the impressions which external modifications have made on the mind.

But both sorts of ideas and thoughts—those called imaginations and those called recollections alike,—are composed of the same materials; and these materials are sensations more internal and late, similar to and derived from the sensations more external and early, through the organs of sense received directly from the impressions of objects situated outside our individual.

Examine whatever picture of the mind, whatever idea or thought we please—the most late and, in the relative order of its lesser component parts, most differently combined from those of mere recollections, and we shall find that, only in the relative order in time and place in which these are situated differing from the component parts of mere recollections, they in their intrinsic nature and materials still resemble, or are the same, with the materials of mere recollections.

We shall find that only, as it were, by a mechanism, again different from the external mechanism that enables certain external modifications directly to play upon and to affect certain keys or instruments of sound, and more late and internal than that former mechanism, out of the same cords are drawn sounds, in their intrinsic nature still similar to the former, but only in their relative order in time and place less or more different from these.

And again examine and analyse whatever recollection itself we please, we shall find that, only differing from mere actual sensations received directly through the external sense from the impressions of external objects and modifications, in the period later and more distant in which they are received from these impressions, they still are received from and depend ultimately upon certain of these themselves. We shall find that, though no longer depending upon the actual presence of the impressions from without, on which actual present sensations of external objects depend, they only in this particular alone differ from these, and still more remotely and distantly depend upon certain of these impressions themselves for their existence.

But these recollections no longer depending upon the actual presence of the external objects, from which they are derived, and which they represent—able, after these sensations from with-even after those objects no longer are present, has already a beginning of mind, of faculties of thought.

Already in very early periods of ancient history certain heathen philosophers, not deeply versed in natural science, but forcibly struck with the power of summoning up in the mind a sensation, an idea, an impression of external objects or modifications, when these objects and modifications that were the first cause of these ideas and impressions no longer were present, or even existed, conceived a notion that the mind, in which such ideas could arise, must in its nature and origin be entirely different from the nature and origin of matter. This opinion, this doctrine, seems entirely of pagan origin.

Plato adopted it from the east. Though unable, as every one else after him has been, to explain how material organs were able, from material objects and modifications withoutside them, to receive even the very first sensations of the external sense, before these material organs again produced other later material organs again in their turn able to prolong these impressions on the sense, in what has been called the mind, this first difficulty of his subject seems not to have startled him. Seeing evidently that the sensations of the external sense only arose out of material objects, in peculiar organs themselves composed of matter, he did not call the occurrence in question, merely because he could not account for the way in which the wonder was effected.

But with regard to the mind, which seems more independent of external time and place, only because its organs are more concealed in the inside of the frame, and because their impressions are less visible to the eye, the difficulty of their receiving of impressions of mere matter a degree of consciousness—though in itself only offering difficulties in their turn arising out of those that already oppose the belief in mere organs of sense receiving of impressions of matter a degree of consciousness,—struck him more forcibly.

He therefore imagined, as others had done before him, that, independent of the sensations of the body and sense, and independent of those inner sensations and ideas of the mind, which still from their strong resemblance to sensations of the sense, and from their evidently immediately arising out of those sensations of the sense, could not be denied being in their nature and origin identical with the same, there were other ideas in the mind by him called archetypes, which arose not out of impressions of the sense, but in their nature and origin were distinct from these.

This idea, first transmitted to us from the most ancient times through Plato, has been revived by modern philosophers, such as by Kant, under the name of idealism, or of transcendental philosophy—not considering that the very words ideal and idealism, coming from the verb ideo—to see—itself only means a mental resumption of that operation of the sight which had first begun in the mere sense.

Leibnitz, indeed, anxious to support the doctrine of the pure immateriality of the soul or mind, first already conceived by certain heathen philosophers, and at the same time puzzled by the resemblance between these ideas and the sensations of the sense, had, in order to give to the ideas of the mind a nature and an origin totally distinct from that of the sensations of the sense which they resembled, and at the same time in order to account for this resemblance, while he believed certain ideas to be innate, and totally distinct, in their nature and origin, from sensations received from the impressions of objects without, still established, very gratuitously no doubt, between the two phenomena a singular coincidence, borne out by no experience, no fact, which should give each of the sensations of the sense its counterpart in the mind; and this phenomenon he calls pre-established harmony; but this doctrine is too wild, and too unsupported by any thing we see, to have had many adherents. Still the general indefinite belief that the mind must be in its nature different from the body—first broached by heathens—among Christians continues to this day to have many advocates.

There however already arose in ancient times men, who more guided by reason and experience, and less swayed by imagination, formed juster notions. Among these was Aristotle, who regarded all ideas in the mind to be derived from and combined of prior sensations in the sense.

In modern times this doctrine has again been supported, in England by Locke, in France by Condillac; but the vulgar still adhere to the opinion that soul, that mind, are totally distinct from sense.

This belief has been chiefly kept up by our hopes and fears.

We naturally wish for the life which we here enjoy, to be at a later period; and in a later world, hereafter continued—we naturally wish for what we call immortality; and we as naturally believe that if ideas, if mind, can be founded on matter alone, and if, as we think, matter is perishable, mind likewise must perish with matter. So far the reasoning is well conducted, the conclusions are well founded on the premises. But people have even gone further than mere reasonings. They have with these reasonings mixed feelings and bitter feelings. They not only have called those who broached the doctrine that mind originates in matter, materialists; but, considering that doctrine to be subversive of all the objects of our hopes and wishes, they have cast on those who maintained it an indelible odium; they have even loaded them with persecutions. They have not considered in the first place that whether our opinions be true or false, so we take pains justly to found, we are not amenable for them; nor have they considered that if by chance their opinions prove true, we gain nothing by reviling their tendency, and persecuting their authors; and only lose the time and opportunities of which we might have availed ourselves for framing our actions accordingly.

Fortunately they have erred in the very principles on which they founded their conclusions—in stating that matter was perishable.

I allow that we cannot comprehend how, while in some modifications of matter no ideas arise, in other different modifications of matter ideas can and do arise: but is this a reason for disbelieving that ideas can and do arise in matter? There are millions of other phenomena which we are as little able to comprehend, and which we nevertheless most firmly and justly believe.

We cannot, in the first place, comprehend how any thing that is—time, space, force, movement, substance—can first arise where none such was before; that aught perceptible can come of nothing perceptible; and yet we believe that all we see first arose out of nothing perceptible, and believe this most firmly.

We cannot comprehend how time can be pre-

[illegible]

[illegible]

[illegible] conclusions [illegible]

[illegible] the sense, because [illegible] We shall elsewhere [illegible] likewise [illegible] of the mind, which [illegible] resembling the former [illegible] the same source. Though we [illegible] modifications of matter receive these, only because we cannot tell how, and by what virtue inherent in them, they do so! We say, and justly say, that what we call immediate sensations of the impressions of external objects—the mere act of receiving from certain modifications of matter, in certain other modifications of matter, sensations, perceptions, consciousness of the sense—is an effect of a faculty residing in matter: but I ask whether this is a phenomenon more easily explainable by us than the act of the same causes having, in other modifications of matter, produced the sensations of mind—the ideas—of which we become aware. Yet the one we acknowledge to be, because we see it clearly, and the other, which we might equally see, we deny.

Things are not to be disbelieved merely because they are wonderful. If they were, we should believe nothing, for all is subject of wonder. The first creation is the greatest wonder of all. Later wonders only deserve to be disbelieved, where they are found to have no analogy with, not to arise out of, but to contradict, and to disagree with that and other prior wonders, already firmly and on just grounds established and believed.

Now, what is the case with the wonder of mind not growing out of matter, and with that of mind growing out of matter? In what does the latter wonder more disagree with all former wonders?

Is not God the first cause of matter as well as of mind: has not God even given matter precedence over mind? Do not the first attributes of matter lie as inscrutable in the bosom of God—of its first author—as those of mind? Has not even matter confessedly received from God the power of experiencing, in consequence of impressions from other earlier modifications of matter, certain consciousnesses called sensations of the same? Is not therefore the wonder of matter also receiving the consciousnesses of other matter called ideas of the mind, a wonder more flowing out of and in analogy with all former wonders, than would be on the contrary the wonder of this faculty of the mind not flowing out of any faculties of matter? It is a wonder which, so far from destroying our hopes of immortality, can establish that doctrine on a train of inferences and inductions more firmly established and more connected with each other than the have fraught matter itself, from its very beginning, with all the attributes necessary to develope into mind, as well as he can have from the first made the attributes of mind wholly different from those of matter, only in order afterwards by an imperceptible and incomprehensible link to join the two together?

We cannot, it is true, deny that of the very first, and most general, and most comprehensive base and ingredients of all matter more late and partial, mere time and space, every portion, wherever it is perceived, is already perceived only as different from every other different portion of the same attributes of duration and of extension: that all time and all space appears as mere change, as nothing but change: that all else we can perceive within perceptions of mere time and space, founded upon and included in certain of these perceptions themselves, must also partake of their nature: that force, impulse, pressure, resistance to pressure, movement and even immobility, formed of time and space, and in time and space, likewise only exist through constant change: that substance and the feel of substance, arising out of pressure, is only the effect and the feel of a constant change: that not only change but stationariness, continuation, and the feel of these attributes, founded on the existence and the feel of change in time or in place or in both, is founded on the real attribute is a change in place, in time, or in both: that the [illegible] of the rock most durable, most unchanging, most stationary, most lasting both in time and in space, always changing in its situation in time, and, if the earth itself constantly moves in space, also with the earth itself in space, always changes: if we perceive objects organised and living, we cannot deny that they only appear liable to changes more rapid and more varied; to those of birth, development, maturation, decline and death: and if we also feel them as sentient, we only feel them as again to the changes of the body superadding those of the sense. We cannot deny that the attributes of mere vitality and even of sensation experience a change so rapid that it is supposed that in man, after the lapse of seven years, not one single particle remains of the elements that existed seven years before: nay, that, as all entities have their definite period of birth, of life, and of development, so they have also their definite period of death and of decombination.

But whether, like the phenomena of the body and those of the sense, those of the mind rest on organs of a material sort, or whether they do not rest on any such, we cannot deny that they too, as far as we know them, constantly change, till at last they again cease to be, and are decombined.

We cannot deny that when in an embryo first only composed of matter arises a mind; when the infant, first only conscious of feeling, also begins to think; when, from thoughts which are only recollections of the past, he passes over to ideas which are anticipations of the future; when from mere concrete thoughts he passes to abstract thoughts; when from truths he passes to errors; from less to more experience; when with his ideas and beliefs, his wills, wishes, dispositions and habits, change; when from a puling infant he becomes a wary man, or again, from a shrewd man degenerates in a doting elder; when he acquires passions, or again loses them, constantly changes in mind as in body—that constantly of the mind, as of the body, the faculties and dispositions come, and go, and are replaced by others, till at last the whole aggregate again is decombined, and for a time, as well as the faculties of matter and of sense it contained, disappears.

But is this a reason why mind, if it rests on matter, and the matter itself on which it rests, must entirely perish, must be annihilated? Is the temporary reverting of the mind, and of the sense itself out of which that mind developes, to their original component elements, a reason for thinking that they cannot again at another later period and in another higher globe again be recombined, and with more splendour than before? If certain combinations of matter first produced sense and mind, of which certain decombinations of that matter again for a time suspend the existence and exertion, why cannot other later recombinations of that same matter, in forms again different, recompose a body more perfect, a mind more capacious than the first? Already in the present period of time, and on the present globe, a man may, from a state of feeling and of thinking, fall in a state of dreamless sleep. He may in that state from England be conveyed to France. He may at a later period, in a different place, not merely again awake, again feel, and again think, but, through the connexion which during his lethargy has still continued to take place between successive changing forms of matter, sense, and mind, so feel his sensations and his thoughts revived, that the new sensations shall only appear a continuation of the former ones; that his identity shall not seem disturbed; that all his former recollections shall resume their empire; that he shall at a later period, on awaking in France, with spirits exhilarated, with faculties refreshed, still only appear the same person who a few hours before, with spirits harassed and depressed, lapsed in sleep and torpor in England. And what should prevent, after the greater decombination, the longer sleep of death, of the elements that here have been decombined, that hence have fled, on another globe, the recombination from taking place, the consciousness from reviving on a greater scale than before? What should hinder that not only of the different genera, and of the different individuals of each genus, that have here and on other second rate globes been decombined, the elements, again reunited in a single individual, should in that single entity revive recollections of the past fate of all these different prior entities, and should form anticipations of its own future fate, infinitely further prolonged, more extensive, more poised, more perfect, more protected against accidents and evil, than any that can take place at the present period, and on the present globe. Thus would, through dint of that very change in matter which we call its perishing—through dint of that very decombination which we deplore,—matter and mind be led to a recombination more perfect, more lasting, more desirable than any which we could on any good grounds expect, supposing mind to have no attributes in common with matter: and not only reason, analogy, every inference we can draw independent of the words of Scripture, assure us that this will be the case; but the very words of Scripture are a warrant for this species of immortality.

The New Testament does not after death here promise us hereafter a soul unconnected with matter, and which has no connexion with our present mind: a soul independent of time and space. That is a fanciful idea not founded on its expressions, when taken in their just and real meaning.

On the contrary it promises us a mind, like the present, founded on time and space: since [illegible] the present, to hold a certain situation in time, and a certain locality in space. But it may [illegible] periods of time and in space different from the present: a mind [illegible] or matter more extended, more [illegible] and more [illegible]: a mind which, [illegible] different globes, [illegible] into the past, and [illegible] the future than any [illegible] a mind which, freed from the [illegible] incidental to [illegible] on this globe, will be exempt from the changes [illegible] to which in the present globe mind as well as matter is liable, and will only thenceforth experience the changes for the better, which [illegible] will alone continue to [illegible]: a mind which, no longer fearing the [illegible] the [illegible] deterioration, to which it is subject on this globe, will thenceforth continue [illegible] and immortal.

As to the attribute of time not continuing hereafter—the base of these changes hitherto all founded on time—as to time ceasing, though these other changes to which time is requisite continue—as to space continuing to exist, and ourselves continuing to exist, even in another world, in space, and not continuing to exist in time—as to some individuals who yet continue to exist in other respects, no longer continuing to exist in time, while others still do, these are all things which we cannot conceive, and therefore cannot reason upon.

CHAPTER XXIV.

Further observations on the nature of mind.

Having thus tried, and I hope succeeded, to do away the great objection to the doctrine of mind arising out of matter,—a doctrine chiefly founded on the fear of mind being thereby less secure of immortality,—I shall only hastily touch upon the lighter reasons for supposing that mind does not, like sense, originate in matter.

Mind has been thought to differ from sense, and consequently from matter, because, while, of all sensations of the sense more partial and complex than those of mere time and space, we strongly and clearly feel the collocation in certain portions of the sensations of time and space themselves, we do not so strongly and clearly feel the collocation of all the ideas of the mind, later and more complex than those of time and space, in certain ideas of time and space: because, while, of the points of time and space in which are only received sensations of the sense,—being immediately connected with the more external points of time and space, from whence come the impressions which occasion those sensations,—the outline, extent and locality are by these other sensations distinctly and definitely marked, of the ideas of the mind, separated from the impressions and sensations of the body by an interval of time and space of which we have no perception, the outline, extent and locality are, by these other sensations, less desirably marked and perceptible, and only in general appear, the one later and the other more internal than those points in time and space, in which arise the external sensations which precede and surround them; and because, compared with certain immediate sensations from without, certain ideas of these, such as those called comparisons, discriminations, abstractions and generalisations, of time and space occupy portions so short and so minute, that we do not take them into account at all.

But still even these ideas like all former ones, and like the sensations of present objects out of which they proceed, themselves, when analyzed, are found to have their different component portions successive and simultaneous each placed before or after, above or underneath, to the right or the left of certain other portions of the same attribute; and thus are found to occupy certain portions of the idea of time and space, as well as to hold a certain situation in real time and place.

Mind has been thought to differ from sense, because, while we feel that sensations, always coming directly from impressions from without, correspond visibly in their locality with the locality in time and place of the external objects from which they directly come, ideas, only coming from these impressions through the medium of intervening organs in the body, often, in the order in time and place of their component parts no longer correspond with the order of these impressions received directly from without, and with that of the sensations directly received from these impressions in the external sense: as they no longer do in images and fancies.

But this is only because in the body, the channels through which impressions first received from without in the organs of the sense produce in the mind actual sensations, afford them time and space to receive in both a new relative order before they reach the seat of those sensations. It is only a difference similar to that which may exist between the music directly by the external hand performed on an instrument, and the different music by an internal mechanism produced on the keys of the same instrument. The sounds still are the same, but the relative order and combination of these sounds is different.

The more thus we think, the more, on the one hand, the reasons for disbelieving that the faculties of the mind arise out of those of the sense fall away, and the more, on the other hand, the reasons for believing that the faculties of the mind do arise out of those of the sense gain strength. We believe the faculties of the mind arise out of those of the sense, in the first place because they still resemble these former so much that while asleep in our dreams, or while awake in deliria, and even without delirium in those creations of the mind, which have arisen so long ago as to make us forget what in them is mere recollection, and what image, nay, even in sensations more recent, which we receive when we very suddenly in rapid alternations open and shut our hands and eyes, we confound what part of these sensations comes immediately from impressions made by external objects on the sense, and what other part are only recollections of such impressions prolonged in the mind. In the second place we believe that ideas still have a common origin with sensations, because they still are affected by the same external changes and modifications in matter by which sensations of the sense are already affected—accidents, opium, intoxication, ague, fever, age, weakness, disease, indigestion, dyspepsia, bile, too much or too little blood determined to the head, phlebotomy, purging, and whatever else affects the body and the sense, also affects the mind: – because in the same way as in the body and the seat of the sense there are various organs evidently serving for different purposes, there are also in the brain, in the seat of the mind, organs as various, as justly proportioned to the faculties of the mind, and as entirely arising out of the prior and more external organs of the sense and of vitality, as those of the sense and of vitality themselves in their turn do arise out of prior more external elements from without; and because, unless these organs of the brain serve as instruments for the faculties of the mind, they seem to answer no purpose whatever.

At the same time I do not believe that Gall has yet exactly ascertained in which peculiar organ of the brain resides each peculiar faculty of the mind; because he could not have done so without also ascertaining how the different faculties of the mind are connected with each other, and without becoming a good metaphysician; whereas he seems to have been a very bad one; and to have on every occasion confounded with dispositions of the sense, dispositions of the mind, and with the effects of radical and generic defects, the consequences only of later and more superficial disturbances.

Since we have shown that as soon as in animals, to the faculty of feeling,—of receiving sensations and consciousness of impressions directly coming from without, and produced by the contact of external objects and modifications,—are added recollections of such, no longer derived from the actual contact of external objects, but, even in the absence of these, continued or resumed by the continuance of the impressions they still, after themselves departing, leave in the body, it follows of course, that in the earliest and simplest of animals in which to actual sensations of impressions from without are added recollections of such from within, are already to faculties of sense also added faculties of mind.

CHAPTER XXV.

Nervous system.

I HAVE in the preceding chapter either expressly stated, or at least must have given room to infer, that of the blood, from within the animal system driven out, a part was with part of the elements from without pressing on and taken into that system, immediately under its epidermis and near its surface combined into a new fluid called nervous, of which a part was again solidified into the first and most external orifices of the organs of sense.

That only on the muscle, from which the blood, after first partly forming this muscle, again partly flowed out, partly from this blood flowing out, and partly from external elements flowing in, was formed this nervous fluid, consolidated into these external orifices of the organs of sense.

That according as on the muscle, with blood from within flowing out, by the suction of that muscle, were combined elements from without of peculiar sorts, these organs of sense themselves became organs of different species:—of mere touch, of taste, of smell, of hearing or of sight, and thus capable, when matured, of experiencing sensations of these different senses.

That of these organs of sense the first origin and most external parts were not nerves, or elongated tubes; since nerves are only later vascular organs or ducts, again arising out of prior cellular organs or glands, and again conveying the fluid, first forming those glands, through them to a further distance; and since faculties of sensation already appear in animals in which no nerves yet are found to exist.

That we therefore do better in calling both the organs in which are the roots and foundation of faculties of sensation, and those later prolongations of them, in which sensation actually arises, papillæ, as being a word expressive of very minute glands.

That these organs of sense—these papillæ—first began, not from the inside of the animal frame and so as to grow outward; since the origin of the sensations themselves begins from the outside of the body and grows inwards; since it is contrary to analogy that the first elements of peculiar organs should come from a quarter opposite to that from which come the forms in which their faculties are first felt; since organs of sensation only first were capable of arising out of the same fluid whose later and greater influx afterwards awakens them to actual sensation; and since there are animals who already have sensations without showing any internal focus whence any organs of sensation sprout outward.

That in certain animals, by greater suction from within, and greater influx of elements of sensation from without were, in the organs of sensation, on the faculties of receiving by a preponderant proportion of the elements from without, sensations of external objects, again founded later faculties of receiving, from a preponderant proportion of the elements or blood from within, later continuations or repetitions of these sensations from without, in the shape of sensations from within, called no longer sensations of sense but of mind,—no longer sensations of impressions from without, but recollections of such impressions from within.

That the internal seats or organs of both sorts of impressions are the same; that the organs themselves, formed of the same sort of elements, are the same; that the impressions are of a similar sort; that the difference between those sensations that come directly from without, under the name of sensations of external objects—of impressions of the sense—and those that come from within, under the name of ideas from within—of recollections of the former impressions—of impressions of the mind—lies in this, that in the nervous fluid producing the former, the elements from without preponderate, and that in the nervous fluid producing the latter—but which in the organs of sensation can only be produced, after the former have matured them for the same—the elements or blood from within preponderate.

That while from without the influxes of elements causing actual sensations of external objects, or from within the influxes of blood causing recollections of these, are in such moderate quantities, and so proportionate to each other, as to benefit the organs of sensation, to increase and invigorate them, and to produce in them orgasm and protrusion, the feel of these impressions is pleasant.

That when in the organs of sensation from without, and of thought from within, of elements causing actual sensations of external objects, or of blood causing recollections of them, the influxes are in such immoderate quantities, and so disproportionate to each other, as to injure, to enfeeble and to decompose these organs of sensation and thought, and to produce in them depression and shrinking, the feel of the impression becomes irksome.

That while the influx from without or within, in the organs of sensation and thought, from being proportionate, and producing in the organs a present sensation from without, or a recollection of such sensation from within—a sensation of sense or of mind—pleasant, it also produces in the organs a fulness, an orgasm, a protrusion, an ebullition outward, it also produces, with the recollection of the agreeable sensation, a subsequent efflux outward, tending to favour the further combination with more elements from without, and thus to promote the further continuation or renewal of the pleasant sensation from without.

That when, on the contrary, the influx from without or from within in the organs of sensation, from becoming disproportionate, it produces in the organs a present sensation from without, or a recollection of such a sensation from within, disagreeable, it also, at the same time, produces in the organs an exhaustion, an emptiness, a shrinking, a suction of elements from without excessive, to re-establish the proportion, it moreover produces, together with the sensation disagreeable and irksome, a depression, a closing of the organs to further elements from without, tending to shut them out, to prevent their further admittance, and to stop the further disagreeable sensations of external objects, which their admittance would have caused to continue.

That this tendency, by the cause of first impressions from without, and of recollections of such from within, either to continue or renew them, or to discontinue and not to renew them, produced, forms in the mind the one a desire, and the other a fear, and either indistinctly a will; and that the cause which produces internally in the mind this will, produces externally in the body voluntary actions agreeing with the same.

That where in animals, as in zoophytes, there only exists an external surface exposed to air; where there exists not yet, in the shape of an alimentary canal, any internal cavity, or surface, or gulf, exposed to a ramification, a branching off, or partial later stream of the same air, diverted from its general map, there cannot yet, in addition to the external papillæ of the sense, by means of blood driven out be, with aerial elements sucked in, formed any internal papillæ of sense of any sort.

That where, in addition to the external surface, exists such an internal cavity, by the aerial elements penetrating in this cavity, and by the blood exsuding from the same, papillæ of sense capable to receive sensations of impressions made on the coats of these cavities will arise.

That in the simplest animals of the vital insentient parts, composed of fewer different elements, the elasticity and suction still was insufficient to cause the papillæ of sensation, by the blood from within with elements from without, combined, to elongate in nerves inward, which might carry their sensitive extremities farther inward, nearer to, and more in immediate contact with each other.

That in these animals consequently the papillæ of sensation must have the seat of their sensation still remain fixed immediately under the epidermis, near the external surface, far removed from the seat of actual sensation of the other nearest papillæ, and without any immediate communication with these latter; so that in a single vital aggregate of this species, there still must exist as many aggregates, vital and sensitive, distinct and separate from each other—as many individuals, sensitive and mental, that have no immediate connexion—as there may be spread near the surface distinct glands, or papillæ, or foci of sensation, thought, will, impulse and action outward of a voluntary sort, distinct and separate from each other.

That in simpler animals that same want of elasticity and suction, necessary in order of the papillæ of sensation to produce the elongation into nerves inward, and of their impressions the concentration in a single focus, which prevents that concentration, must consequently also of these impressions, and of the recollections of them, prevent the later impulse outward, from proceeding from a single focus.

That as in simpler animals only from the same want of elasticity and suction, necessary to produce vital parts very spreading and very diversified, and wanting further influxes very various to support them, could also arise in the papillæ of sense the want of elongation in nerves inwards, necessary more to concentrate their actual impressions, and sensations, and recollections, and wills, which were again to impel to connected corresponding actions outward, this want in these animals of that elongation and concentration of those papillæ could not in them signify and become detrimental.

That in these animals the mere connexion of their vital insentient parts on which the papillæ of sense must be superstructed, would, between the impulses outward produced in the latter, ensure a sufficient accord and harmony.

That in animals in whom a greater elasticity and suction of the vital parts made them sprout out in extremities more diversified, this greater elasticity and suction would also on their muscles cause the papillæ more different again constructed to elongate and to sprout further inward into ducts called nerves.

That this greater suction would there leave the first glands or papillæ, constructed at the surface of the body, as it were only in the capacity of mere roots or bulbs of the organs of sensation; and would cause these roots to elongate inward in stalks called nerves, and that only where these nerves would inside terminate, would arise at the termination of these glands or papillæ the seat of actual sensation, recollection, sense, mind, ideas, wills, and impulse to voluntary action: which thus, from being spread near the external surface of the body, became transferred to, and concentrated in its interior.

That if through the greater elasticity and suction of the frame, this frame had been made to the external surface to add an external alimentary canal, on the coats of this canal the papillæ again superstructed would naturally be prolonged in nerves inward advancing in a sense opposite to the direction of the nerves from the external surface advancing inward; and which in a certain sense, and to a certain degree, would advance outward.

That these nerves, from the external surface advancing inward, or those from the internal coat advancing outward, would not be fibres of a solid nature, only transmitting mere vibrations; inasmuch as such vibrations could not be effectually produced in organs having so little tension, and so circuitously led through the vital parts as we see nerves to be, but must be tracheæ, ducts, tubes, which, originating in the earlier bulbs outside, through these carry the nervous fluid, similar to that which first formed them, further inside, and at their inner extremity first form the glands, which actually receive the faculty of being by further influx of similar fluid made to feel.

That each external bulb or root of a papilla of sensation, of the mixture of a distinct portion of blood from within and elements from without formed, would in its turn form inward a distinct stalk, stem or nerve, and at its inner end a distinct blossom or papilla of actual sensation; and that what we perceive as single nerves inward are only nervous cords or fasciculi, each composed of numbers of nerves, beginning and ending separately, and only in their intervening course athwart the vital parts pressed together.

That at the point where, from each opposite [illegible] [illegible] [illegible] brain, the nerves, arriving at the surface from more inward, met and formed, as were themselves in their turn met and arrested by the nerves inside, so in the same line on the opposite side, would be formed these ganglia terminating them, so that in the centre of the body [illegible], from distance to distance, be formed pairs of congruous ganglia as seats of sensation, thought, will and voluntary reaction [illegible], [illegible] in number to the length of the body, and called ganglia.

That those from each opposite side of the internal part of the alimentary canal the nerves, arriving at the surface from more inward, and there forming the outer internal actual papillæ of sensation which terminated them, were arrested by obstructions from without, they should arrive into a congruous plane of actual sensation, thought, will and voluntary reaction on the alimentary canal, also called ganglia. That, while the ganglia from opposite sides without formed more inward, and called, rather prematurely, spinal ganglia, since they are formed prior to the formation of the osseous sheath called spine, should appear, by converging, so close together as always to appear in pairs, the ganglia from opposite sides within formed more outward, and called also rather prematurely, intercostal ganglia, since they are formed prior to the formation of osseous concretions, called ribs, should appear, by diverging, so distant as always to appear single.

That where the vital parts sprouted forth in an anterior extremity,—a head,—more complex, the blood from within driven into that head would there, round the external orifices of stomach, lungs,—the outlets of mouth, nose, ears and eyes,—with elements from without, form external roots and internal blossoms or papillæ of organs of sensation more numerous and more varied than were formed over and in the rest of the body; would there form an internal conglobate gland or pair of ganglia, consisting of papillæ more numerous, more varied, more extensive than had been collected in any other part of the body, and which is called by preeminence, brain.

That not only from the nervous fluid from without driven inward would, within, be formed ganglia and brains, and in these ganglia and brains sensations, thoughts and wills, but by the excess of this nervous fluid, again arrested and driven outward, would be formed other ducts or nerves, again carrying that fluid outward into the muscles, or again drawing that fluid already in them again out, and thus causing in that muscle by its influx orgasm and protrusions, which would make them seek further influxes and impressions from without, or, by its withdrawing former influxes from these, causing in them depressions [illegible] [illegible] which would make them avoid, [illegible] [illegible] against further mixtures and impressions from without.

That as the sensibility and suction from without became greater, and drew more elements and also from without inward, this suction would also cause more new nerves from each ganglion to [illegible] [illegible] in each other ganglion, between the ganglia from the surface without, under the name of [illegible] [illegible], and between the ganglia from the alimentary canal within, under that of sympathetic nerves.

That while the superfluous nervous fluid, from each ganglion flowing outward to the surface, would cause an external voluntary reaction analogous to the prior sensations from without, the superfluous nervous fluid from each ganglion flowing through the sympathetic nerves to each neighbouring ganglia would cause in that neighbouring ganglion a participation in the sensations produced in the former internal ganglion.

That as the pair of cerebral ganglia called brain, from the number and diversity of the papillæ of sense of which it was composed, preponderated more in size over the other ganglia, it would also, through its ducts of communication with these, rule them more.

That as the papillæ composing the ganglia called spinal, and particularly those composing that extreme one called brain, were more approximated, they would shoot forth not only in more ducts outward to the external surface, but in more ducts inward to each other, so as to enable the cerebral fluid to be more from one driven to another, and thus, of the elements of perceptions from without and recollections of such from within, to present a greater number collected in a single aggregate of sensations and of recollections.

That as of the papillæ more numerous and more varied forming that extreme pair of ganglia called brain, many nerves, impelled outward, would again from without, by the resistance and counterpressure they there met, be resisted and made to turn inwards, and in the brain revert to the papillæ nearest those from which they issued, and thus establish between those papillæ internal channels of communication, through which the nervous fluid might pass internally from one papilla to another in an order in time and place different from that in which it was made from without to affect these papillæ in impressions coming directly from external objects, and in recollections of such; and might thus be enabled to form internal pictures, in the order of their component parts different from that of mere sensations and mere recollections of such, and called individually images, or discriminations and comparisons between different recollections and images.

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mind, either by the elements from without ce

ing to flow, as at night do those of light, or out, the elements admitted before it began may still, mixed with blood from within, continue to produce sensations from within, called of the mind, such as recollections, images and others, then called dreams, but which, while they continue to be felt exclusively, and thus betray not their want of connexion with the sensations from without, are discovered not to proceed immediately from external objects.

That in simpler animals, possessing only papillæ of sense separate from each other, if they have any dreams, as some may have, these dreams, necessarily having no connexion in their component parts, and, in the collocation in time and place of these component parts thus incapable of offering any difference from that of the component parts of any sensations coming directly from external objects, cannot even while the animal is awake be distinguished from such impressions from without, or from mere recollections of such.

That in animals the form, composition, pressure, elasticity and suction of the earlier and more fundamental mere insentient parts must determine the efflux of blood from within, and the combination with elements from without, and the site, and number, and variety of sentient organs superstructed on the muscle, and their collocation either at the surface external, or also at a surface internal of the body, and their being entirely, in their impression inward and impulse [illegible] [illegible] to the surface, or by the elongation of nerves formed into ganglia and brains more [illegible], which become the focus both of the sensations and impressions from without, and of the will and motions from within outward.

That while in zoophytes the seat of sensation, of [illegible], of will, and of action outward is spread over the whole body, in actinias and medusas and other polypi it seems already more concentrated round the mouth in the shape of [illegible] called tentacula.

That in molluscs, [illegible] anchored in their shells at the bottom of the waves, which float to them their food, which may require dilatation to receive that food while beneficial and grateful, and contraction and closing when that food becomes noxious and painful; who want not locomotion for any purpose of desire or aversion; who fear not the storm raging around them; who require little feeling and no sight, their first ingredients are so combined as to produce little of the organs and sensations of which they want but little.

That in animals like worms, composed of a repetition of vital parts of the same sort very [illegible], internally united, and externally presenting a series of articulations, or rings, strung together, each separate vital part would have its separate ganglia, connected with the ganglia of the rest by a spinal cord running through the whole, and enabling the inward impressions made on each part to react on and establish a concert with the outward actions produced from the other ganglia.

That in animals in whom the earlier and more fundamental vital parts shoot out into a head having a preponderating brain, this brain, by its suction diminishing the power of the inferior ganglia still more, and must more exclusively direct the voluntary impulses and actions outwards of the whole body.

And that even animals having a distinct head, according as they are formed in water, on land, or in air, and want for their future support and increase elements from without less or more rich and varied, will also of these elements receive a less or greater quantity, and thus also receive organs of sensation to perceive these external elements, and organs of voluntary reaction outward to pursue, apprehend, and master the objects whence they proceed, less or more concentrated, and varied, and powerful.

While the mollusca living in water, only for his support wanting to perceive and to let in the nearer elements which surround him, probably has only the sense of feel and of taste, the insect, the bee hovering in air, forh is support wanting from afar to perceive and to approach the distant flower, is already endowed with organs of smell very fine and very ample for the purpose of scenting those flowers, and wings very spreading for that of wafting them to these.

CHAPTER XXVI.

Further proofs of certain of the foregoing statements.

That blood from within the animal frame flowing out forms a principal portion of the nervous fluid which consolidates in organs of sensation, appears since only where blood from within meets elements from without in certain quantities such organs are first formed, and since only where blood from within on these organs flows in greater quantities meets greater quantities of these same elements from without, these faculties are in these organs first awakened, and actual sensations produced.

That elements from without the animal frame flowing in and combined with the elements from within flowing out, form another principal portion of the nervous fluid that consolidates in organs of sensation, appears since only where such elements flow in and combine with blood, these organs are formed: and since as more of these elements mix with more blood, from the mixture arise organs of sensation stronger and more vigorous; and since as organs are less exercised from within, and less exposed to air from without, their faculties of sensation weaken; and since every organ of sensation takes its origin internally in some substance formed of the accumulation of blood from within, and of some element from without, mixed together, which in the organs of touch is called moisture on the skin, in those of taste is called saliva, in those of smell is called mucus; in those of hearing is called wax, and in those of sight is called vitreous humour, and nourishes the organs, and of which the want leaves these organs to starve, to become weak, and to decay.

That the same cause which makes the carcass shoot forth into an anterior extremity called head, and in that anterior extremity makes part of the blood from within attract to it part of the elements from without, also makes at the surface of the face the external materials of the higher organs of sense collect and form these organs, appears since, where these organs are elongated, and only have their papillæ completed in the inside of the head, in that inside also are found certain ventricles in which further blood from within and further aerial elements from without meet, combine and complete them.

That the very attributes, and movements, and pressures of external elements form those organs of sense peculiarly destined to perceive their impressions, appears since, where these impressions, like most of those of touch, only come from external objects in immediate contact with the organ of sense, they occupy the same extent of space as the organ itself; whereas, when these impressions, like those of sight, come from external objects more distant, they are concentrated and reduced in the eye in proportion to the distance they come from; and, according to that greater distance, objects more numerous each impress a smaller space and fewer papillæ in that eye.

That only according as blood from within is, in different parts of the body differently composed and modified, of the different elements from without pressing round that body those that suit it appear combined with it, since in different parts of the body are formed and fed different organs of sense.

That only, as in the organs of each sense the external elements suited to it are made to flow in certain proportions relative to the proportions of the blood from within flowing out, they cause actual sensations of the impressions from without, appears since only after certain elements from without have flown in in certain quantities, such sensations are felt.

That only where by elements from without organs of sense have been so matured as to receive sensations of them, they are thereby prepared to be by the blood from within awakened to later ideas or recollections of these sensations from without, called sensations of the mind, appears, since only after sensations of the sense have first appeared follow sensations of the mind, repeating the impressions of the same objects, already represented by the former sensations of the sense.

That only from influxes and impressions of the blood from within arise in the papillæ of sense the pictures of the mind, appears since a lying posture, a fever, or whatever else determines more blood than usual to the head, also favours thought, and renders its flow more rapid and more copious; since, on the contrary, a large meal, which draws more blood from the head to the stomach, renders the thinking powers torpid; since bleeding often suspends these powers entirely, and causes fainting; since too much thought, by attracting and consuming too much blood in the brain, causes, through want of a sufficiency of blood remaining in the vital parts, ill digestion and dyspepsia; and since blood, from which bile has not been sufficiently discharged, often impairs the faculties of thought, and embrowns the ideas.

That in animals it is only a greater suction inwards which makes the papillæ of sense formed near the surface of the body elongate inward, and only terminate their sentient inner extremity at a distance from their external root, appears since in inferior animals, in which there is less of this suction, no nerves are found, while in higher ones, in which there is more of the same, nerves do appear.

[illegible] pres[illegible] general body [illegible] surfaces [illegible] reach [illegible] acted [illegible] surfaces of the [illegible] ducts [illegible] sides [illegible] thus a[illegible] distinct [illegible] of [illegible] that [illegible] in pairs [illegible] pressure [illegible] detaching [illegible] enters [illegible] presses [illegible] outwards, [illegible] along [illegible] made to [illegible] pro[illegible] ganglia, [illegible] single.

That the same suction from within which in higher animals makes these organs elongate inward, and makes part of the blood from within the body, and part of the air from without that body, be attracted to and meet in the ventricles in which the inner sentient extremities of these sensitive points terminate, and to these inner extremities transfer the power of sensation, which in lower animals began nearer the surface, appears since, in higher animals, from the same cause would proceed both these effects.

That nerves are not solid fibres, but hollow tubes, first formed by, and next conveying onwards, the nervous fluid, which at their inner extremity impresses the papillæ both with sensations of external objects, and with later recollections of such, appears since such is the mode of growth of all bodies arising out of bulbs; since Brodie has discovered that, even where nerves are divided, the nervous fluid continues to flow from one part of the divided duct to the other uninterrupted to a certain distance, and to carry sensations to the brain; and since only the flow of a fluid through the nerves of the brain can account in children for the formation of new ideas being accompanied by a sudden glow in the seat of the mind; for the mathematical calculations often performed by young people without knowing by what process; for the natural and regular attributes of external objects, which produce, and which are retraced in the distribution of the ducts of the brain, being by them remembered, when the arbitrary names attached to these attributes are forgotten; for the flow of ideas being at one time unaccountably stopped, in spite of the greatest efforts to keep it up, and being at another time as unaccountably continued, in spite of the greatest efforts to stop it; for one part of a recollection accidentally kindled reviving another; for association of ideas; for ideas in minds still young, in which the cerebral fluid still flows rapidly, following each other with such ease, and in minds become old and stiff, in which the ducts are dry and hard, being often produced and propagated so slowly, and with such difficulty; for ideas long forgotten and laid by, being by a sudden shock and concussion of the brain, which clears ducts before obstructed, often without any external cause revived, and for a million of other circumstances not otherwise explainable.

That in animals the papillæ of sense and those of mind, whether suffered to be individually completed, and left wholly separate from the next papillæ, near the surface of the body, or whether by intervening nerves their sentient extremity be removed to the brain and connected with the sentient extremity of the next, are still the same papillæ; that where the sensitive powers are retained near the surface of the body, the mental powers are so likewise, and that, where the mental powers are removed to the brain, the sensitive powers are the same; that these latter only appear themselves already to reside in the external roots of the papillæ, near the surface and extremities of the body, because the impression from without that causes them begins already from this former point first visibly to affect that body, and because from this point they travel further inward in the order in time and place in which they are there first received; that the difference between sensations from objects without, and between the later ideas concerning such objects formed within the brain, consists only in the nervous fluid which causes the one being composed of more elements from without, and that which causes the other being composed of more blood from within; and in the organs only being by the influx of the elements proceeding from former first matured for sensations of the impressions received from the latter, appears since we cannot perceive in space a line of demarcation between sensations from without, and recollections of such sensations from within; since sensations flow imperceptibly into ideas.

That if, while sensations of external objects can only be felt in the presence of those objects, and recollections of them can be felt in their absence, this is only because the impressions causing the former sensations, coming directly from the objects themselves, can only come in their presence, and those causing the latter, not coming directly from the objects themselves, but only from fluids carried about with us, may come in their absence, appears since such would be the natural effect of these different sorts of impressions.

That, whether inwardly still terminating near the surface of the body, or whether already at a distance from that surface concentrated in the brain, the papillæ of different senses, and those of the same sense may be in incredible numbers, appears since a single spark of light, which while motionless only produces on a single papilla an impression equally motionless, may, by being twirled round with such rapidity as to make on different papillæ in turn as many different successive impressions, each beginning before the impression on the former papilla has subsided, produce on the whole the collective impression of a complete ring or circle of light.

Indeed, that, as of each sense each organ, destined to feel a sensation, in part different from that felt by any other organ of the same or of a different sense, must be in part composed of elements from without different from those of which is in part composed that other organ, in higher animals of each sense, and particularly of that of sight, the organs as well of the same sort, as of different sorts, each formed first of an external the impressions and sensations of them first came from without, must individually be prodigiously minute, and must collectively be in prodigious great numbers, and must, lastly, be very equally intermixed throughout each separate field of the sense, appears still more evident when we consider that while, on the one hand, we may through each eye receive sensations of the same sort—of the same colour—to a great extent, so continuous as to appear connected in a single mass, we may also, on the other hand, of the different parts of an external object—a prospect for instance—receive simultaneous impressions of sight, each separated from the other by, and intermixed with, other intervening impressions different from themselves, in a thousand different ways, degrees, and proportions.

That in the lobes of the brain of higher animals, the more numerous involutions of the ducts called nerves only arise from these nerves not finding room, any more than do in the body the larger ducts called bowels, to expand and stretch to the full length of their formation, and thus being forced by their integuments to become crumpled up, appears since in hydrocephalus, which mollifies and stretches the skull, the nerves of the brain are also by the pressure outward on that skull made to extend, without the functions of the intellect being thereby impaired; and since, as these involutions, by the amplitude of the nervous ducts, become [illegible] [illegible]. The [illegible] generically appears to have faculties of mind more varied and comprehensive; but since the lesion of the lobes of the brain may impair the faculties of the intellect, without affecting the faculties of mere vitality.

That dreams are only ideas in the mind, similar to the thoughts produced while waking; but produced while the external orifices of the organs of sense are closed to fresh impressions from external objects; and that they only in their form are often more extravagant than waking ideas, because they are no longer guided and controlled by actual perceptions of external objects, appears since in the nature of their lesser component parts and materials, they still resemble waking ideas.

That which in animals is often named the spinal cord, even before there yet exists any spine, is only the fasciculus of the different nerves, partly from the external root of the papillæ of sense prolonged inward to the ganglia and brain, and partly from the ganglia or brain again prolonged outward to the external muscles of voluntary action, which these ducts, in desires, by pouring nervous fluid in them cause to swell, protrude and advance, and in aversions, by drawing nervous fluid out of them cause to shrink, collapse and close; that only by pressure upon them in their passage athwart the vital parts, these nerves formed and carrying fluids in opposite directions, appear united, is evident since everywhere the nervous cord appears double.

That, where behind the brain proper is found a cerebellum, this is the ganglion, or brain, or focus of perception, which from the sensitive papillæ, called intercostal, conveys impulse and reaction to the muscles situated over these parts, appears since it holds behind the brain the situation and performs the functions of such an intermediate organ.

That of the influxes from the external surface, which produce sensations and recollections of such, and desires and wills, the recoil outwards in its turn produces effluxes, which, when again reaching the surface of the muscles, in them cause orgasm and protrusion and ebullition of the nervous fluid, appears since desires of external sensations, when strong, are accompanied by peculiar movements in the external muscles, even in the absence of the external modifications which might correspond to these advances, and satisfy these desires;—desires of peculiar sensations of the sense of feel producing orgasm, shivering and ebullition in the limbs and organs in which reside the chief papillæ of feel; desires of peculiar enjoyments of the sense of taste producing watering of the mouth and smacking of the lips; desires of peculiar scents producing dilatations and snuffing up of the nostrils; desires of peculiar sounds of music, producing an expansion and a pricking up of the ears; and even a desire of peculiar sights producing a tension and gloating in the eyes, beyond what is commonly experienced, and which motions are calculated, where externally exist and are present the modifications, capable of meeting those desires, to gratify them, by combining with these effluxes more copious from within, these influxes from without in a more effectual manner; and aversions in the same way causing, even in the absence of external modifications that are the objects of them, a peculiar shrinking and retraction in the peculiar external organs, which, if the modifications causing that aversion were present, would produce the avoidance of these.

That these effluxes of nervous fluid from the brain, which accompany desires, and stimulate the external muscles to inflate and to satisfy them, really take place, and really complete in the nervous fluid, as in the blood, a circulation first from without inward, and next from within outward, appears since in human beings, of which the wishes or avocations tend to peculiar actions or exercises, the muscles employed in these exercises acquire an unusual swell and vigour; as in singers those of the throat, in dancers those of the legs, in wrestlers those of the arms, in town criers those of the lungs, &c.

CHAPTER XXVII.

Further detail of how, in different animals, according as their first and fundamental vital parts, not yet sentient, have an elasticity and power of suction less or greater, arise on these vital parts organs of sense and mind less or more developed.

I HAVE, I hope, established that from the vital parts of animals flows out blood, which with elements from without is made to be, on the muscle and near the surface, combined in nervous fluid, and in part consolidated in nervous solids or papillæ, capable of taking further similar blood from within, and similar elements from without, in them, till by these later influxes more matured, they are by still further influxes of the elements from without, and by the impressions these make, awakened into actual sensations of them; and when thus matured, even in the absence of further influxes from without, and by mere further influx of the blood from within, and by the impressions this makes, they are aroused into further internal continuations and resumptions of these sensations from without, called recollections and ideas of the mind, and which, though they cannot begin to be felt except where sensations of the sense have preceded them, can be continued, and resumed, and carried about, after these impressions and influxes from without, that first caused them, have ceased to act. I have, I hope, established, that while the influxes from without are in quantities benefiting the organs of sensation, the sensations of them are pleasant; and that while the influxes from within are in quantities benefiting these organs, the recollections of them are pleasant; that while the influxes are in such proportions as to render the sensations and recollections pleasant, they are also in such proportions as to cause an efflux backward and outward to the muscles, productive in these muscles of a swell, an orgasm, and an efflux which, where more of the elements from without continue to hover round, causes a new suction of, and combination with, and impression by these; and that when the influxes of elements from without, or of blood from within, become so excessive and disproportionate as to cause the sensations or recollections to grow painful, they cause in the external muscles, with which the organs of sensation communicate, a retraction, a withdrawing, a suction upward and inwards to the brain of the fluid already in them, in order to supply the deficiency, that causes the organs of sense, superstructed on these muscles, to shrink, to collapse and to close against fresh influxes from without of the same elements, before grateful, even when these continue from without to flow to the body; that however much the influxes from without may, by their excess, render the actual sensation painful, while the influxes from within, causing the recollection of these sensations, are moderate, these recollections of them remain so pleasant, that we often are detected dwelling with pleasure on the memory of sensations which were in themselves productive of pain. I have observed that the actual sensations of external objects are no longer the objects themselves, but only effects of the impressions they leave; but that even later recollections of these impressions still intrinsically are realities; that both in present sensations of external objects and in later recollections of these sensations, the instruments on which the impressions are made are the same; that the impressions caused, the one by somewhat more elements from without, and the other, somewhat later by somewhat more blood from within, are in substance similar; and that the sensations arising from the latter still strongly resemble the sensations arising from the former.

I shall now resume, advance and extend my inferences. I shall first repeat, that in the vital parts of animals least exceeding those of mere vegetables in elasticity and power of motion, not only the earliest and most external, but the later and more internal half of the organs or papillæ of sensation, thought, desire, aversion, will and impulse outward to the muscle to perform actions corresponding with the desire, or retraction from the muscle without, of the fluid necessary to keep the organs of sensation open to further influx of external elements, are still both alike formed near the surface external and internal of the body, and at a distance from the interior of the frame, and distinct from the other neighbouring organs of the same sort contained in the same frame; and thus in that single vital aggregate or frame still form a number of individuals, sensitive and mental, distinct from each other, which, however, by the unity and connexion of the vital aggregate on which they are grafted, and by the little variety in the position and offices of its different parts, fully suffice to lead to perceptions, thoughts, inclinations or aversions, wills and impulses outwards, tending to the general benefit and enjoyment of that whole aggregate.

The organs of vitality more elastic, and endowed with greater powers of suction, of other animals, would make their papillæ of sensation and thought inward, and of corresponding desire, aversion, will and action outward, only leave their first and fundamental roots near the surface of the body, and cause these roots to elongate in nerves inwards, which would carry their inner extremities, actually capable of sensation and of thought, further from their outer extremities, and from the surface of the body, and nearer to and more in contact with each other, and more anastomosing together; and would in their turn also cause the nerves outward, by the recoil and efflux of the fluid from these former nerves inward produced, also to go outward to a greater distance, before they again reached the external muscle, on which the external outposts of the organs of sensation rested; and thus would, when the organs of sensation were matured for actual sensation and recollection, and desire and aversion, and will and impulse inward and outward, from the circulation of the nervous fluid to and from a focus of papillæ more numerous and more concentrated, arise, first an impulse first to sensation inward, and next, an impulse to voluntary action outward, also more extensive and more concentrated.

In sleep, when no sensations from without can be continued, recollections of former sensations from without may be continued in the shape of dreams. Dogs and parrots must have powerful recollections when, in their sleep, the former bark, the latter prate. The faculty, residing in certain organs, and in certain portions of the nervous fluid, of recalling the impressions, before having caused sensations from without, in the shape of recollections of these sensations from within, is itself termed memory, and, as, in organs of sense, recollections of sensations from without are by the nervous fluid more easily revived, and last longer, the memory is said to become more tenacious.

In other animals organs of vitality still more elastic, and endowed with powers of motion still greater, would make the internal nerves or the papillæ of sensation and mind, thus pressed close together, sprout out in nerves of communication between them, through which the nervous fluid might flow, and might cause, of the sensations received from without, later recollections in an order of time and place different from the order of time and place in which these sensations first came directly from external objects, and in which last different order they are generally called imagination, though as that word confounds the [illegible] [illegible] producing these new pictures of the [illegible] [illegible] in certain organs, with its manifestation [illegible] actual peculiar individual instances, [illegible] [illegible] the word imagination for the faculty [illegible] producing such pictures, and for the [illegible] [illegible] themselves substitute the word ideas.

the cart before the horse. We may see the event which in reality preceded another event as posterior to that other.

In the young minds of children, images, formed without design, and by the mere exuberance of the nervous fluid made to wander through the first ducts that between the papillæ of sensation and thought present themselves in its way, will precisely be the most crude, the least composed with intention and method, the most unlike the sensations of actual impressions received from without, and the recollections of such;—ships sailing on dry land, cities floating on the sea; beasts with the faculties of men, men with the limbs of beasts.

Yet even these, when summoned up in the mind during sleep, and in the absence of actual sensations from without, with which to compare them, and to show the difference they present, will themselves pass for such sensations from without, and by the effluxes toward or retractions from the muscle outward which they cause, make us feel desires or apprehensions.

Even awake, when the rush of blood from the body to the brain is so great as to cause delirium, or when in the brain itself there is a circulation ill conducted, the images most unlike sensations of external objects, will, by their intensity, often pass for such actual sensations or perception of external present objects.

When in the mind arise ducts more numerous, and when that mind is more accustomed to receive sensations from, and to entertain recollections of past impressions from without, the images in the mind will themselves by habit become so constituted as more to resemble recollections. We shall form images of things past, never actually beheld, more resembling recollections of things past actually beheld; of things future, of which all pictures in the mind must be images, we shall behold images, more resembling recollections of things past actually beheld; and actual sensations from without, recollections of former sensations from without, and images may, in the organs of sensation and thought capable of receiving them, by degrees arise intermixed with each other. Even of external objects already gone by, or not yet come—past or future—the images, however, while they arise, themselves are present. A picture is in itself a present reality, though it be the representation of the first creation of man, or of the last judgment.

In other animals, of the vital parts the still greater elasticity and suction, producing in these vital parts themselves a greater variety, and requiring a greater discrimination in the sensations to be sought for the benefit of each part in particular, would with the new want also produce its new remedy. It would produce nervous ducts able to separate certain recollections and images from certain others: to mark in what attributes they, and the external objects which they represented, differed from each other, and in what attributes they resembled each other;—to form discriminations and comparisons.

Discriminations, or the sense of difference, must precede comparisons, or the act by which attributes, felt to be different from each other, are not only recognised in what they are different from each other, but also considered in what they again may resemble each other. Nothing can be compared with itself; nay, can be thought either unlike or even again like another thing different from it till it has first been felt to be different from that other thing. Discrimination, or the sense of difference, must thus first arise involuntarily and unintentionally, before comparisons can arise, and can produce a more minute and detailed sense of what other different things only are different, and what other things, though different, again resemble each these former. All things, though different in their more superficial qualities, must resemble each other in their shares in certain more fundamental attributes, such as time, space, quantity, size, number, of which they each must possess certain portions; or in certain later effects, such as of pleasure or pain, heat or cold, of which they each may produce certain portions; and it is in these only that they can be found to resemble each other.

In their peculiar intermediate intrinsic attributes themselves they can only differ. A taste, a smell, a sound, a sight, each only individually are what they are, in those attributes in which they each differ from the other.

The sensation of difference between attributes and objects is produced by the sensations, the recollections and the images of them, being by the nervous fluid simultaneously summoned up, so as to have these differences perceived, and the sensation of the similarity between attributes and objects is produced by the sensations, the recollections and the images of them, being by that nervous fluid summoned up, so as to have the portions they each occupy in the sensations and ideas of the common attributes of time, space, quantity, &c. or the portions they each produce in the common effects of pleasure or pain, or others, through each other compared, and measured, and felt to fall short of, or to exceed, to resemble, or to differ from those of the other.

In human beings the ducts, necessary to form comparisons, are so numerous, and the cerebral fluid that forms these comparisons is so exuberant and so active, that often children, particularly in the higher human tribes, already for the mere pleasure derived from the act, form comparisons, without end as without object.

In the vital parts of animals, that same superior elasticity and suction that, for their benefit, would require and produce greater faculties of discrimination and of comparison, would also require and produce greater faculties of option, of preference, and greater liabilities to indecision, to irresolution. From the papillæ of sensation and of recollection, of desire, of aversion, of will, and of impulse outward to voluntary action, would arise ducts through which, if these ducts could not all be impelled to action at the same time, —if the action of some impeded and obstructed the action of the others,—by the nervous fluid only those in which that fluid rushed with most vehemence would be impelled to immediate action, and by that rush the more feeble rush through the others be postponed or prevented; or, where the rush through two or more nerves, whose action was incompatible, was begun, that rush would only produce a real external struggle and conflict, and an apparent external inaction and repose, lasting until the efflux through one of these nerves outward had got the better of that through the others, had entirely subdued and quieted these other nerves, and had alone reached the outward muscle, and in the same produced a movement corresponding to the impulse from within.

This state of internal irresolution, suspense, and conflict, while it lasts, is so far from being a state of repose, that nothing worries the mind more than the option between two actions between which it cannot decide. This doubt always fatigues and distresses the mind, and often, when very harassing, by the flux of nervous fluid from within which it begins but cannot bring to a conclusion and vent, distresses even the external muscles of the body, as we see by the trembling, the truncated movements, the contortions, the dancing about, the seesaws, the races to and fro, in the muscles of the body by it produced, and the evident relief which ensues, even when a resolution, which we know to lead to an action unpleasant in its later consequences, has at last gained the victory.

We cannot have a certainty of any sensation which we receive being a sensation derived from a peculiar earlier and more external cause. When through my sensations of feel and of sight I am made to believe that holding my finger in the flame of a candle produces in that finger the sensation of heat, and the pain of a burn, this is only a belief. The whole may be a dream.

Still when the nervous fluid has, by running often through certain ducts to certain papillæ, caused in these papillæ certain sensations, and certain recollections of them to follow certain other prior sensations and recollections so closely, as to enlarge the communications that lead from the former papillæ to the latter, and to cause the nervous fluid to run from the one to the other spontaneously, it produces associations of ideas; and when these associations are formed irresistibly—when we cannot withstand the impulse that with the idea of some entity or event connects the idea of some other peculiar entity or event, these associations of ideas grow into positive beliefs, that the external objects or events which produced these associations are themselves connected; that certain of them produce the others, or arise out of these others.

A dog who, taking possession of a piece of meat, has experienced a pleasant taste, will, when he again sees a piece of meat, connect with the idea of taking possession of that meat the image of a pleasant taste; expect such a taste, and be tempted to take the meat. When after taking it he has been whipped, he will with the idea of the prior pleasure resulting from the act, connect the idea of a later pain following that pleasure, and with the idea of the future pleasure resulting from a future similar act, also connect the idea of a future similar pain. If the idea of the pain preponderates over that of the pleasure, he will resist the temptation, and leave the meat untouched. Thus arise from sensations and recollections of prior actions, beliefs, expectations, and from these consequent impulses to produce or to avoid such actions in future.

When through the nervous ducts, through which certain ideas were associated, the nervous from causes as first, these ducts, before widened and strengthened, may again shrink and wear away, and so impeding the circulation of the fluid through them, the associations of peculiar ideas cease, without any other ideas contradictory to, and incompatible with them opposing, superseding and taking their place: but even before their natural extinction, if through certain ducts arise beliefs, founded on associations more extensive and mature, which no longer leave room for the former, the nervous fluid may in forming these new beliefs so impede the continuation of the former one, as, from mental certainties to make them dwindle into doubts, and ultimately change into positive disbeliefs.

Thus the external causes of sensations first produce recollections; of the materials of these recollections the recombinations produce images, these images produce beliefs, and the preponderating of certain beliefs over certain others again produces doubts and disbeliefs of the external existence, reality and truth of what we first believed.

In human beings the slightest associations of ideas, as long as not counteracted by other associations of ideas stronger and more irresistible, will produce beliefs. As these beings grow up, those beliefs will again be counteracted and destroyed by other beliefs stronger and more enduring, and which, of the external reality of the things represented by the former, again produce later doubts and positive disbeliefs. Children, and savages, who always remain children, and the lower orders, who always remain in some respects savages, are very credulous: they believe many things of which the more mature comparison of ideas produces a doubt or a disbelief. As men grow older, experience more, and reflect more on what they experience, ideas, even by good reasons before proved to be just and true, are by later reasons, still better and stronger, again proved to be unfounded and fallacious. Man only judges of the truth of another man's beliefs by the strength of his own.

There is a vast difference between a mere want of belief in a thing, which want only arises from the idea of that thing not yet being associated with that of another thing regarded as certain; a belief in it very faint, and arising from an association very weak with another thing regarded as certain; a belief in it very strong, arising from an association very extensive and very powerful, with another regarded as certain, a doubt between the belief in two or more things incompatible with each other, but which is founded on associations with both which, whether weak or strong, are of equal strength and extent; and a positive disbelief in one thing, which only arises from a stronger belief in another thing, incompatible with that first.

Some men have, for want of the ideas or

images of certain things being associated with those of certain other things, regarded as certain, a mere want of belief in those things, where others have a belief in them, others have a doubt between the belief in them and an equal belief in other things incompatible with them, and others again entertain a positive disbelief in them.

The beliefs conceived in youth, while the organs still are ductile and pliant, and still with ease, in consequence of slight associations of ideas, conceive beliefs, which are cherished and confirmed as the ducts grow more matured, more firm, and less liable to change, are beliefs seldom again weakened and dismissed when in old age, the ducts, become inflexible and stiff, resist circulation of fluid and associations formed thereby new and different, even when proceeding from data more extensive and more nicely poised.

Thus it is that of ghost stories often repeated, and of superstitions strongly impressed, in early childhood, the belief still often remains firm in the imagination of man matured, even after his expanding reason has begun, when leisurely consulted, of their truth to entertain a doubt, or even to conceive a positive disbelief.

And when interest is on the side of a belief, and makes one anxious to resist the influx of another contrary belief, even where intrinsically founded on a more extensive base, the struggle against conviction becomes from positive desire still greater, and more certain of ending in victory.

All this, however, does not prove that external certainties do not or cannot exist. It only proves that we cannot of these certainties obtain any certain knowledge; and yet as it seems that our mental organs, and the knowledge which we receive through those organs, proceed from external modifications, the probability is that these beliefs must naturally agree with these modifications; that the mental fluid, by these modifications impelled must, when flowing through these ducts rightly, and unbiassed in its course by impediments and obstructions, lead to beliefs and conclusions corresponding with external realities; and that the more the mind is in its ducts extended and enlarged, and the more, as long as through these the cerebral fluid is rightly conducted, the beliefs in the realities of nature will become not only more numerous and more varied, but more just.

Not only people derive beliefs from those sensations of feel, sight and other senses, which they receive from external modifications independent of other men, but they also derive beliefs from the sensations received by other men, and, through the medium of these other men, communicated to and instilled into their minds. Thus are peculiar tenets very generally made to spread, and dunned in the ears of youth, till they become articles of faith in the minds of age.

When the beliefs in certain things are not prevented by the beliefs in other things, with which they first are regarded as incompatible, we consider the things as possible. When these beliefs become very powerful, we regard the things as probable, or as certain; when the belief in them is again shaken by that more firm in other things regarded as incompatible with them, we call them improbable, and when the belief in them is entirely subverted by that in others, regarded as certain, we call them impossible.

Belief in things grateful begets, in addition to the desire of these things, when they are still regarded as future, hope; and belief in things unpleasant begets, in addition to the aversion which these things inspire, when they are still regarded as future, apprehension and fear.

Let me here, for the better understanding both of what precedes and of what is to follow, again insist on what, I fear, I have not sufficiently pointed out before, as soon as I began, in animals more complex than the very simplest, of the roots of the organs of sense, which always must remain situated at the surface of the body external or internal, whence impressions from without are first to proceed inward, to describe the elongation inward in ducts or nerves ending in ganglia or brains, in which these influxes and impressions from without first of external objects, whence they come, produce consciousness or sensations of, as well as later recollections and thoughts concerning them, namely, that firstly, since sensations of the sense and later thoughts of the mind only differ in the former already being in certain organs, chiefly by influxes and impressions directly from without, and the latter only being, where the former have preceded and prepared the organs for them, in these very same organs, by influxes and impressions chiefly coming from the blood within, produced, they must alike still only from opposite sides in the very same organs and spot, be each produced; and thus, where the whole of each individual organ of sense and of mind begins and ends separately near the surface of the body, also only both alike be produced near that surface; whereas, on the contrary, where the root of each organ individually presents elongations, or ducts and nerves inward, which cause its internal and sensitive half and extremity to be carried further inward, and to be more approximated to and concentrated with its neighbours in internal ganglia or brains, sensations of external objects and recollections or thoughts concerning such, must alike also only in those internal ganglia or brains be produced; and that, secondly, if, even where the first consciousness and sensation of influxes and impressions from without, as well as all later recollections of and thoughts concerning such sensations, only first takes place in more internal ganglia or brains, the first sensa-

CHAPTER XXVIII.

Faculties of abstraction or reason.

THE highest mental faculties which I have thus far described, are still only those of producing ideas of external objects, called concrete; that is to say, ideas of external objects in their capacity as individuals, each represented as in their own peculiar component parts, those similar to as well as those different from the component parts of the ideas or representations of other entities of the same or of other different sorts, represented as equally distinct and detached from these other ideas; and of these mental faculties the very highest still are collectively only called instinct.

But there are on this globe entities of which the first and most fundamental vital parts, in which they take their beginning, already composed of the meeting and combination of elements finer and more varied than those of the entities thus far described, as they develope show an elasticity and power of suction of new elements from without, so much greater than any yet described, as, on the organs of sensation and intellect already set forth, to superstruct other organs of intellect not yet mentioned, but destined, when matured, to evince faculties by none of the organs thus far described yet possessed, which are called faculties of abstraction, or collectively, of reason; and while the entities in whom only can develope the mental faculties thus far described, are simply called brutes, these superior entities receive the name of human beings.

It is easily understood that in these new entities, different from all former ones, the very first organs and faculties different from those of all former entities, were not merely at a later period, only superstructed upon and added to other organs and faculties still similar to and possessed in common with the first and most fundamental sort in brutes—that a man was not up to a certain point a mere monkey, and then made to receive the forms and faculties that again distinguished him from a monkey,—that entities beginning as brutes, could not ultimately by any superadded qualities end as human beings. No, for in such a case there would be no impediment why any entity, beginning as a brute, should not end as a human being.—A brute might then perhaps by superior care be nursed and cultivated into a human being, as a common working bee is by superior food converted into a queen bee, a thing which has never yet been witnessed.

From his very first beginning a human being must already have been composed of the combination of elements, so much more varied and fine than those of which was first composed even the highest of brutes, as already to prepare room and latitude in the later superstructure for those higher organs and faculties of abstraction, which no brute is ever capable of forming and receiving; and in man all the formations and developments, from the very first mere insentient vital ones in which his individual existence commences, must already be different from, more complex than and superior to the corresponding developments of any brute, in order to admit of this superior capacity.

It seems that in human beings out of the first and most fundamental substances and forms already superior to those of any brute, was composed a blood in its elements so much richer than that of any brute, that when by the centrifugal pressure of the frame this blood driven out, and made on the muscle of the external and internal surface—on the body and the alimentary canal—with fresh elements from without to combine into nervous fluid, in its turn first consolidated into the roots of the organs of different senses, it already combined into organs experiencing a power of suction inward so much greater than the nervous fluid and first solids of the organs of sense of any brute, even the highest, experienced, that not only of the inner and sentient extremities of these organs fewer tarried in the inferior and earlier parts of the body—in the inferior and lesser ganglia that are found along the spine, short of the brain—that already of these inner extremities of the sensitive organs a greater number were attracted to, and collected and concentrated in that brain—so that these ganglia in the body lost in size and in number of papillæ and powers of present sensation from without, what the brain gained in these respects,—but that moreover in the brain itself, from the greater exuberance of and impulse given to the nervous fluid, sprung forth between its papillæ ducts or nerves anastomosing, and conducting this nervous fluid from one papilla to another, not only so much more numerous, more elongated, and more variously distributed as to become capable, when matured, of leading the cerebral fluid to form sensations and ideas—recollections, images and others—of various individuals of the same and of different sorts, still concrete, more extensive and varied, than could arise in any brute, but, moreover, so much more ductile as when the cerebral fluid, in the formation and repetition of these concrete ideas, naturally passed oftener through the ducts leading to the papillæ representing the attributes on which the different individuals represented still resembled each other, and which still left them of the same genus, than through those leading to the papillæ representing the attributes in which these different individuals again differed from each other, and which again rendered them different and distinct individuals, to make this fluid extend and fortify the former ducts, leading to the representation of these former attributes, much more, and give them much greater amplitude than the latter ducts leading to the representations of the latter attributes. Thus by degrees the cerebral fluid, after forming concrete ideas, in forming which the same papillæ, each time they were called upon to represent in the ideas of different entities similar attributes, were to be excited and struck afresh, of the portions of each attribute in which all the different individuals, simultaneous and successive of each sort still resembled each other, and belonged to the same species, at one single time would form one single picture or idea, from this process of abstracting its materials from divers prior concrete ideas, called an abstraction, or abstract idea or picture.

This for instance we do when, having first received from without, or conceived from within the mind, of different individuals of the human species, simultaneous or successive, ideas, each distinct from the rest in the portions they individually possess of time and space, and size and beauty, and other attributes, but each still, in the portions of these attributes, resembling each other, we leave out of the concrete representations of these entities, formed in our mind, the representation of the attributes which in each individual is dissimilar to the others, and renders it a distinct and different individual, and only keep and summon up in that mind the representation of the attributes through which each individual still resembles the rest, and through which each individual still belongs to the same genus with the rest; and cause these latter attributes, however distinct and separate they are in the originals, to be represented in the mind by the same papillæ, and thus of the human genus, of however many individuals, simultaneous and successive, different from each other, that genus be composed, and however many separate concrete ideas of these should be formed, if we wished to represent each separately at full length, cause the whole to be represented in a single abstract mental picture.

It is natural that the same cerebral ducts which lead the cerebral fluid from the formation of concrete ideas to that of abstract ideas, can also again lead that fluid back from the formation of abstract ideas to that of concrete ideas. That, having of the concrete ideas of different individual men formed the abstract idea of man, void of those differences, we should again be able to combine with this abstract idea of man, the concrete ideas of those dissimilarities, later seen or imagined in different human individuals.

And of these faculties of forming in the mind abstract pictures, like all other mental faculties, founded on peculiar organs, and on peculiar organs arising in man alone, the collective mass is called that of faculties of reason.

Even in different men there may arise organs and faculties of abstraction and of reason which, to their more fundamental organs vital, sensitive and intellectual, owe a development less or more extended; there may arise brains better or worse organized.

Nay, even brains originally of the same quality, as they are afterwards less or more exercised—as in being made to form concrete ideas less or more extended and varied, the cerebral fluid is made less or more frequently to pass through the same ducts, and to widen and strengthen those ducts through which it passes in its way to the papillæ, representing the same attributes in different external individuals, in a less or a greater degree, will be able out of concrete ideas to form abstract ideas, less or more extensive and varied, and again from these abstract ideas to lead back to other concrete ideas, less or more extensive and varied, with less or greater ease and readiness.

While one person may only, of a few superficial attributes belonging to a few men, and of a few individual men only forming a common species, such as that of either blacks or whites, conceive an abstract idea, another person may, of attributes more deep laid and more fundamental, but of which the portions, like those which all created entities necessarily occupy of time and space, must link together man, brutes, vegetables, minerals, and in fine all that we can know and conceive in one genus, in his mind form a single abstract idea.

But to the last, abstract ideas may be founded on prior concrete ideas that are true or conformable to external objects, or untrue and discordant with external realities. Abstract ideas may thus, like concrete ideas themselves, be right or be wrong; reason itself may be just or may err; and we do not speak grammatically when we call ideas founded upon processes of reasoning, often very varied, very complex, but ill conducted, irrational; we should admit their still being rational or effects of reason, but only, as effects of reason ill conducted, condemn and call them errors of reason.

CHAPTER XXIX.

From the greater acuteness of their sensations, the instinct of brutes often already in peculiar effects assumes the appearance of reason.

Many species of entities, still only able to receive and to produce mere concrete ideas, still only possessed of instinct, still unendowed with reason, still only entitled to the appellation of brutes, still in reality destitute of the distinctive characteristics of human beings, are already, nevertheless, through dint of their mere present perceptions of external modifications, so much stronger than those which human beings receive, by a shorter cut and by modes less circuitous, made to show external faculties, and to perform external voluntary actions, so much more directly and surely conducive to the purposes intended, than those which man, for similar purposes, through the circuitous medium of his powers of abstraction and reason frames and executes, that they are already erroneously called effects and works of art, a term only rightly bestowed on productions of the faculty of reason; though in reality they still are only productions of mere nature, before it has in animals caused and developed the organs and faculties of abstraction, necessary to produce the works legitimately called works of art.

We admire in the ant his thrift, in the bee his clever contrivances, in the spider his curious web, in the fox his cunning, in the dove his connubial affection, in the pelican her maternal love, in the dog his fidelity to his master; we blame the peacock for his pride, the magpie for his pilfering propensities, the tiger for his cruelty, the monkey for his tricks; we even feel gratitude to certain animals for the services they render us; we love them for their social disposition; we wonder that certain of them should immediately on emerging from the egg shell already perform for their benefit with certainty and precision, certain actions and works which man, after years of apprenticeship, with all his superior faculties, does not so well perform; and we thus in many instances give these brutes credit for mental capacities which human beings do not possess.

If in reality these animals performed the actions, executed the works, showed the propensities which we admire in them, in consequence of the intellectual stimulus to which we attribute these phenomena—to the effect of reflection, of foresight, and of reason,—not only they would possess powers of abstraction, but would even possess these powers in a higher degree than man himself. They often do off hand, and as by inspiration, at an early age, and in the most perfect manner, what man, after much observation and experience, only often, by slow degrees, imperfectly learns to perform.

Their superiority, beginning earlier, would in age be maintained. Unless there were ostensible and adequate reasons for retarding the progress of later generations, or for making these retrograde, they would to the last maintain that superiority over man they had so early evinced. Every later generation, taught by the preceding ones, and adding its own experience to the lessons of its predecessors, would add new skill to the skill of former generations, and excel them more; above all, those brutes that show themselves very superior to man in one respect, would also show themselves much to excel him in every other faculty connected with that first. Their superiority, arising from the same stimulus as his, would in all things connected with each other evince a certain relative proportion.

The brute most early excelling in certain processes, certain works, would not to the present day remain the least skilful in certain others related to these first: the bee of the present day would not in point of capacity remain exactly at the point to which rose the first bee of the creation; the beaver in old age would not be condemned to show in his architecture no superiority over the beaver just brought forth, except what a little more maturity and strength in his corporeal organs might be expected to give him.

Above all, where the skill and knowledge of man had been employed in cultivating the capacities of brutes, these brutes would, for their superior acquirements, be more esteemed by their fellow brutes that had been left in their state of natural rudeness.

But the reverse of all this is the real case. The brutes most remarkable for the early acuteness of certain of their organs of sense, for their early proficiency in certain peculiar works—and which generally are precisely among the inferior sort of animals—are those most woefully deficient in other respects. Those that on issuing from the egg shell most immediately show themselves most perfect in certain operations in which man only succeeds after years of trial, never even in these proficiencies make any further progress; nor do they show the least capacity for others, for which, had their skill proceeded from a mental stimulus, they must have shown a proportionate disposition. Among them no later generations improve upon the natural capacities or the works of earlier generations. Nay, if a beast has been admitted to companionship with man; if by man he has, for man's own purposes, been taught processes in which the rest of his species has been left deficient; and wishes with his new acquirements to revisit his native forest, far from becoming by the display of these new talents more acceptable to his fellow brutes, he is by these ignorants shunned, regarded as contaminated, fled from or repelled. A beast or bird taught by man, who strays into his native wilds, is driven away by the whole herd of his former companions. He is only by these former comrades considered as having lost his natural instinct, in proportion as he has acquired the arts of man. He is thenceforth condemned to remain in the region of unmodified nature an exile and a wanderer.

The truth seems to be that in brutes, no doubt in consequence of their papillæ of sensation and thought having their vigour and strength less drawn off and wasted in later nerves or ducts of communication formed between them, than are the corresponding organs in man, have these papillæ, whether they be of touch, taste, smell, hearing or sight, susceptible of present sensations of external modifications, more acute than are the papillæ of sensation of man; that, from gravitation, electricity, cold, heat, elements of savour, odour, sound and sight, generically beneficial to these organs, and capable of giving them agreeable sensations, they derive directly much earlier, and from a much greater distance, sensations agreeable, and calculated to make them seek a continuation or a resumption of these sensations; and that from these same attributes, as soon as becoming generically injurious to these organs, and capable of giving them sensations irksome and disagreeable, they also derive directly much earlier and from a much greater distance, sensations disagreeable, and calculated to make them flee from and seek a discontinuance of these sensations; that they need, in order to obtain the former sort of sensations, and to shrink from the latter sort, the circuitous stimulus of thought, and of the bad effects these sensations may eventually produce, much less than man; and that these organs of present sensation inward so much more acute, and so much less having their quickness wasted in developing in later ducts of intellect than those of man, are again immediately developed in organs of reaction outward, by the peculiar impulse given them, much more nicely calculated to develop in the forms necessary to obtain the fewer elements that are generically beneficial to them, and to flee from or repel those other elements that are generically noxious to them than those of man. That through the bounty only of nature directly, and without any contrivance invented by their own ingenuity or reason, as long as they receive from without elements beneficial and sensations grateful, they are by their very mechanism made to seek the continuation or resumption of these sensations, and that, as soon as they receive from without elements injurious and sensations irksome and unpleasant, they are by that same mechanism made to avoid their continuance or resumption, more immediately and forcibly than man.

That in reality brutes each of certain external modifications, receive sensations much more acute than man, cannot be doubted, when we see the effect of electricity on certain fish and fowl; when we see the dog, through the mere smell, trace athwart the grass the track of the hare, which remains unperceived by man; when we see in air a hawk watching a mouse peeping from a hole in the earth which man cannot, though much nearer, discern; when we see brutes watchful of sounds and sights which man passes unnoticed.

At the same time, while in brutes the sensation of the peculiar elements of which their organs of sense are composed, is so much more powerful than it is in man, they each have organs of sense only composed of elements so much fewer and less varied than those of man, that the dog who smells the scent of game most unerringly, will not be diverted from his scent by, nor indeed smell the odour of the strongest herbs, among which he hunts out his prey.

Thus it appears, that of mere electricity the modifications, the changes and the stimulus are already by the most inferior brutes so strongly felt, as alone to suffice to impel certain molusca and insects, certain fishes and birds, to peculiar movements and migrations with such unanimity and precision, and in an order of march so well calculated to overcome the pressure they have to encounter, that they will all be seen to sally forth and to set out the same day and hour, and to cleave the wide expanse of the ocean or the air, without knowing what they fly from, what they seek, and whither they are bound, in the order and direction best calculated to lead them with certainty and precision to the regions, however distant, where they are by nature destined to halt; that the quail, prevented from following his comrades, will, in his impotent efforts to liberate himself from his confinement, break his head against the bars of his cage; and that thus by brutes long voyages are performed through the mere ordinary impulse of a fluid, of whose pressure man, unless it is more than usually condensed, or unless in a morbid state his organs of feel become more than usually sensible to its impressions, remains unconscious.

Thus it is that through the impressions of taste alone, brutes are made to feed on whatever is salutary to them, and to abstain from touching whatever may injure their constitution; nay, are only made to consume the particular food, congenial to their frame, as long as it contributes to their welfare, and to leave off feeding the moment they have had sufficient nutriment; that those animals, first only formed of vegetable matter, and consequently only wanting vegetable matter for their further support, are only allured by the flavour of vegetables, and are by the effluvia of animal matter, injurious to their organs, nauseated and repelled; that even from a great distance, and without yet knowing that he is threatened by any real danger, without yet even seeing his natural enemy, the ox or the horse flies from the forest where lurks the lion or the tiger; and, when the latter pursues and presses strongly upon him, the one with his horns, and the other with his hoofs, attempts their repulsion and his defence.

Thus it is that the oyster, as long as the water on which he feeds is beneficial, and consequently is grateful to him, is made to swell and protrude his muscle, and thereby to take in more thereof; but the moment he is sated, by the mere repletion that substance causes in his organs of sense, is made to loathe any further influx, and to close to it his shell.

Only the higher brutes, which have more powers of intellect, will sometimes by the allurements of the sense be betrayed into actions eventually noxious: the ox indulge in the rich pasture till he bursts; the elephant eat sugar-plums till he turns sick at the stomach.

It is not by any nice discrimination of the respective attributes of any fellow worms, still less by the consideration of the effects, physical or moral, of any misalliance with them, that the mollusca, the worm, avoids any mixture of races; that he is prevented, in the darkness of his subaqueous or subterraneous abode, from committing a rape on a mollusca or worm of a different sort. It is that the effluvia of a worm of the same sort alone can attract him; that the effluvia, of a different sort even of worms, repel and nauseate him.

Nay, even when a brute is attracted by the effluvia of other brutes of the same species, so little do in their origin the effervescences, the ebullitions of the spirits that lead to aggressions of love or of war, differ from each other, that he knows not yet whether he approaches a female or a male of his species, and whether he is going to give proofs of concupiscence or of aversion; that it must only depend on the reception he meets with, whether he shall vent his ardour in caresses or in combats; that the first risings and symptoms of lust and of anger differ but little. Of the male the first approaches always seem hostile; he begins with pursuit, and the female responds with flight or repulse. If the feelings of the sex at last subdue her, she submits; but even in spiders the act of union only takes place after mutual advances and retreats, resembling those of animals entertaining fears at least equal to their desires, and doubtful whether they approach to caress or to be devoured. In the feline tribe love scenes to the last are accompanied by violence—by biting and scratching; and in the human beings of the lower tribes and classes, the demonstrations of lust still differ little from the symptoms of anger.

If the animal is, by the effervescence of his spirits, made to approach another of his species, who like himself is a male, who leaves him not room to vent his ebullitions in acts of love; who feels an effervescence of the same sort with his own in an opposite direction, who receives his advances with corresponding repulses, the excitement which began in attraction, for want of vent, ends in irritation and in combat; and thus it is that of each brute species the males, especially in the season of love, are constantly at war. The gentlest stallion will in that season, when he finds not the means of venting his ardour, become so excited as to bite or kick his own master.

Again, if every brute, for defence or for attack, uses exactly the organs best adapted for the purpose required; if the oyster, when pressed, closes his shell; if the seppia, when pursued, voids his inky liquor, and escapes under an impenetrable cloud; if the crab and the beetle, when touched, lock their pincers; if the wasp protrudes his sting; if the horse shows his hoofs and the ox his horns; if the tiger uncases his fangs and claws; these movements do not proceed from the animals having nicely calculated their means of attack and of defence; they only proceed from those peculiar organs, which the rush and efflux from within has begun to render most strong and most active, naturally continuing to be those which, on any sudden excitement or emergency, this rush of the spirits to them disposes first and most preferably to any act of attack or defence.

Already in his infancy every animal is, by that same rush to the parts which it renders strongest and most active, impelled in his very sports and gambols to use by preference the same organs, to which he afterwards most trusts for success in his more serious engagements. The colt already kicks in play with his hoofs, the kid already buts with his still hornless forehead, the kitten tries to catch the toy with his still innoxious paws, the puppy already gnaws with his still toothless gums.

Let us view how in some most inferior brutes mere present impressions from without on the sense—mere instinct—impel them spontaneously with the greatest precision to acts, already in their effect similar to certain of those which in man are only the circuitous result of the nicest calculations of the mind.

When the bee, dignified by the name of queen—that is to say, one whom the organs of generation, fully developed, enable to perform the sexual functions—has laid eggs, of which some, by the full assemblage of all their component elements, develope into perfect females or queens similar to the mother, and of which others, from the deficiency of certain of these elements, only develope into females less complete, less able to attain the full development of their sexual organs, and destined only for toil, the first of the young queens that emerges from her cradle, already is by the excitement which the effluvia of the other queens, still torpid in their cells, cause in her, induced to seek, to go round to, and to destroy in the bud those others, which, if suffered to live and to grow, might become her rivals; while, on the contrary, by the relief she experiences in venting her own effluvia on the workers who want these emanations, there arises between her and those workers that relationship which, through life, produces in the former her influence, her sway over her subjects, and in the latter their obsequiousness to their queen, their neutrality between two queens that fight for supremacy, and, when they have entirely lost the queen from whom they imbibed the effluvia grateful to them, and on whom they in their turn, as readily for the sake of riddance, of the food they had collected, bestowed the richer portion, by themselves nauseated, now vent it on some young worker, who, thus sumptuously fed, herself grows into a queen. In the morning, the mere scent from a great distance attracts the bee to the flowers. At eve, and even earlier in the daytime, on the approach of a storm, the mere disappearance of the sun's rays, and the consequent chill, sends the bee back to the hive. The mere weight of the honey and wax she has gathered makes her, on her return, hasten to clear herself of the incumbrance; and where so many bodies, so close pressed, with one accord push away from them two such different substances as wax and honey, the more cohering naturally takes the octagon form we so much admire, and the more liquid flows in the intervening interstices. In the cells that remain empty, the queen, when oppressed by her eggs, finds for these ova the most ready receptacle. That in the acts of the bee, which at first sight seem to us the effects of so much forethought, there is no intellectual stimulus, may be easily proved. Deprive a bee of her antennæ, the instruments through which she receives the effluvia by which she is ruled, and the spell of her curious demonstrations is broken at once. From an animal replete with activity, with ingenuity, with contrivance, she becomes a stupid, helpless, torpid brute; she has lost all her nice feelings of order, of subordination, of loyalty and of thrift; she becomes henceforth in the populous and busy hive, an isolated, dull and forlorn wanderer, without interest or occupation.

The ant likewise is only by present sensations stimulated to his various actions and fabrics. That he has in performing these no intellectual motive, no forecast, is proved by his still continuing to perform them when they no longer can answer any beneficial purposes.

Even the spider is only by her solicitude to get rid of the viscous matter which loads her stomach made to extract and to spin it in the form of that fine thread, of which the web serves to her securing more food, and of which the form obliges her to hold in that web the situation best calculated to watch the inroads of her future prey. When the struggles of the victim have damaged the net, its substance produces the fresh effluxes by which that net is repaired.

The bird species, so organized that the sort by pre-eminence called the Weaver, is made by its sensations, even when single, and in a cage, to weave round its bars the tissue of a nest, without yet destining that nest for any peculiar purpose, when impregnated is made, from the weight of the egg in its womb, to derive a restlessness, which seeks vent in forming the receptacle best suited to her forms and organs. In this nest her increasing uneasiness makes her seek repose, deposit her dropping burthen, and, without knowing whether it be an egg or a stone, sit on the same, to relieve her breast of its oppressive heat. When one side is warm and solaces her no longer, she by mere instinct turns to her body its other and cooler side. Thus she hatches her young, and to get rid of the food that oppresses her stomach, pours it into their ready maws, till each being reciprocally strengthened, and no longer wanting the other, goes its own way, without there remaining on the mother's side a trace of that affection which seemed to have inspired cares so varied, so protracted and so patient.

If the tigress defends her whelps which the tiger seeks to devour, she only defends that which during the weakness which follows parturition, disburthens her of her troublesome milk, and gives her a welcome warmth.

If the dog, inconstant to his canine mistress, is faithful to his master, defends during his master's life his person and property against aggression, and after his death often follows him to the grave, it is that of that master the effluvia are become necessary to his existence. In defending his master he only defends what he considers his own property, his own means of enjoyment and of comfort. If weaned from these he sallies forth, sniffs up the air, and, as soon as he finds another person whose effluvia agree with his constitution, seeks no further; his election is made,—he follows that person home as pertinaciously as he had done his first protector.

If the monkey mimicks man, it is neither from admiration of his superior merit, nor from ridicule of his manners. The eye is in the monkey the ruling organ; the impressions of sight those that exert over him the greatest power. Man's habits and movements, through the organs of sight of the monkey, produce in that brute's brain an excitement, which he can only vent by performing similar movements. On seeing the reflection of his own person in a mirror, he experiences a similar agitation, turns the object which interposes between himself and his image round and round, and seeing that image escape him, in his fury dashes the glass to the ground, and puts an end to the delusion.

If in the season of sexual desire the males of certain brute species utter cries which the females of the same species answer, it is not that they understand each other, it is only that the cries uttered by the former, in consequence of their feelings, excite in the latter, through the sense of hearing, similar feelings.

If certain animals are gregarious; if they seem to obey a leader, this is not from their having any mental conviction of the advantages of society; it is only because they enjoy each other's atmosphere, and are most influenced by that of the strongest and most vigorous individual of the herd.

If in the South American pampas the blood of a slaughtered ox collects around it all the oxen of the neighbourhood, and causes them to roar and to bellow, it is not that they deplore the loss of their comrade, and excite each other to revenge his death; it is only that the sight of a red object raises in these quadrupeds the same fury it gives rise to in turkies, and other birds.

If an owl, who ventures forth in the daytime, gathers round him all the other birds of the forest: if in the same way a human being collects round him all the monkies of the wood: if in these brutes arise a hooting and hissing, which increases till it grows into insults and outrages still more tangible, this is not the effect of moral causes or considerations: it proceeds only from the physical excitement produced by a sight so unwonted.

If the magpie steals the silver spoon, this is only in consequence of the general fondness of birds for substances calculated to form a nest. The magpie collects the worthless stick with equal care, and often drops the piece of plate with equal indifference.

The lion's bravery is a fiction. Hunger only is his stimulus, and fear of his foe soon makes him turn tail. The horse appears more daring, but this only proceeds from his greater ignorance of danger. While he rushes heedless among the enemy, he trembles at his own shadow.

Entities yet only possessed of mental organs, capable at best of forming mere concrete ideas of external individuals, entities and modifications, in their character as individuals distinct from other individuals of the same species, as well as from other different species, not in their character as parts of species more extensive and durable; entities unable yet to conceive ideas of attributes as belonging to whole genera; entities incapable of forming abstractions and generalisations—entities, in short, only distinguished by the appellation of brutes, and not yet entitled to the name of human beings,—can attain none of that knowledge of attributes and modifications which they perceive, as pertaining to, as forming essential parts of every individual belonging to a genus, which knowledge we particularly and pointedly call science; nor can they form any ideas of transferring any of these attributes and modifications from the species which by nature possessed them, to other species who do not—of combining together productions and modifications of nature, before separate and distinct,—which we call processes of art, of whatever sort they be; and whether only called mimicry, which purely consists in making the limbs, features and other faculties, supplied by nature, perform movements and actions not prompted by mere nature, but suggested only by the sight of the movements exhibited by other entities; or whether by the desire of more permanent attributes of certain external entities being applied to other entities who possessed them not before, they be more pointedly distinguished by the name of imitation; whether called of invention, representation, classification or method; whether for purposes of utility only, or for purposes of direct gratification; and whether finally for purposes of gratification to the lower senses, called pleasure, only, or for purposes of gratification to the higher senses of hearing and sight, and to the mind, called beauty.

If the parrot seems to mimic sounds, and to use an artificial and conventional language, it is only that those sounds striking his ear, produce in his sense of hearing an impression so agreeable as to make the ebullition, thence transmitted to the organs of reaction outward, situated in his throat, in these organs produce movements, in their turn producing similar sounds, without his attaching to them any peculiar meaning, or producing them with any peculiar intention of mimicry.

If the monkey seems to mimic movements and actions, to walk and to behave like man, it is only that the peculiar carriage and behaviour of man, striking his eye, produce in his sense of sight an impression so forcible as to make the effervescence, thence transmitted to his organs of reaction outward, situated in the limbs and features, in these produce movements in their turn producing a semblance of similar actions, but also without his attaching to these actions any particular meaning, or even performing them in consequence of any design to mimic.

No entity yet incapable to form any abstract idea—no brute—can yet be capable of feeling those sentiments, those dispositions, those desires and those aversions, those impulses toward and those shrinkings from certain external entities and modifications, which only arising from the same cause from which arise abstract ideas, are called mental propensities, and when very forcible, are termed passions. They can neither feel love, friendship, benevolence, affection connubial, parental, or social, gratitude or esteem, if by these words we understand affections which only proceed from abstract views of certain qualities in certain entities; but as they are not capable of harbouring feelings friendly to others, they are not either capable of harbouring feelings unfriendly to them; as they cannot feel mental sympathy, they cannot feel mental antipathy. They are not liable to anger, to fear, to jealousy, if by these words we mean, no longer the aversion merely arising from a bodily sensation, or a mental recollection of a disagreeable sensation, positively already at a particular time and in a particular place produced or imagined in the sense, but that aversion arising from the idea of such a sensation produceable in indefinite and abstract portions of the idea of time and place. Susceptible of irritation in consequence of an injury done or imagined, they are not susceptible of anger in the abstract; susceptible of dislike, bition, avarice and other passions, injurious to themselves or others. As they cannot feel an abstract wish to please, they cannot feel an abstract desire of injuring any other individual. As the gentlest dove has no sympathy with another dove in distress, the tiger, most arraigned for cruelty, tears his prey in pieces, without any idea of injuring a fellow creature, without any view but that of promoting his own bodily gratification.

CHAPTER XXX.

Of ideas simply called concrete, the only sort conceivable by brutes, and the first sort conceivable by human beings, the merits and demerits, the advantages and disadvantages, compared with those of ideas called abstract.

Of external objects and modifications in time and in place distinct from other objects and modifications of the same sort, or of other different sorts:—of external objects and modifications, as individuals different from other individuals simultaneous with or successive to them,—the concrete ideas, which represent each in their dissimilarities to, as well as similarities with the others, and which consequently may represent each in its full length and in all its attributes, may give in the mind an idea more complete, more accurate, more definite, more in all its details like the original represented, more fully and truly representing that original, than the abstract idea, which leaves out of the representation of that original that of its dissimilarities to other individuals of the same sort, and only gives that of certain of its similarities to these, condensed in a single picture, and produced in a single set of papillæ of sensation and of thought.

The abstract idea, of a number of individual entities and modifications of the same sort, different in time, place or other circumstances, from each other, which leaves out that of these differences, and only retains that of the similarities concealed under these differences, cannot convey that of other dissimilarities yet unseen, arising from those beheld, which nevertheless must in reality arise from these, and must be taken into consideration, in our estimate of their advantages and disadvantages, of their tendencies good or bad, of the eligibility of seeking or of avoiding them; and must consequently influence our actions and our conduct. We are, in acting in consequence of abstractions and generalisations, on less sure grounds, than in acting in consequence of concrete ideas of individuals.

But as concrete ideas represent external objects and modifications more at full length, not only in their similarities but in their dissimilarities; as of each individual entity which they do represent, they represent the similarities as well as the dissimilarities by different papillæ, or at least by the same papillæ at a different period of time, their representation must in the brain occupy so much more space and time, and employ so many more different papillæ than that of abstract attributes and modifications, that the most capacious brain of the most long lived man can contain, can find in time and space room for concrete ideas of far fewer individual objects and modifications, in which are represented their dissimilarities as well as similarities, than it can contain, can find time and space for abstract ideas, in which of these objects and modifications the dissimilarities are entirely left out, and the similarities only lumped together, and represented by the same papillæ.

We shall only of a small number of men carry away an idea fraught with all the diversities that distinguish the fate of each singly from that of the others; but we shall of the genus called man, easily embrace a general idea in certain of the attributes which belong to and confound together all the individuals of the genus.

The mind of any single individual therefore, however capacious, can only afford room for a limited number of concrete ideas, and when it wants more such ideas, on which again to construct others, and to found consequent resolves and actions, must out of these concrete ideas draw abstract ideas, calculated to render their calculations more concise, more condensed, but more indefinite and less certain.

Abstract ideas are thus in entities, whose situation requires and renders necessary resolves and actions outward very numerous and varied, to the prior concrete ideas, a necessary and an advantageous supplement. They aid us in forming gross calculations without the incumbrance of details.

At the same time they are only of external objects representations abridged, indefinite, and as it were produced by a short-hand method often very inaccurate, and giving but an imperfect, a vague, and frequently a very erroneous notion of the originals they represent. If they facilitate more extensive calculations, we can less depend upon the justness of these calculations: upon their applying to every possible case.

But we can in much less time and space form calculations much more extensive, more varied, more comprehensive, more applicable to time, space and other objects in general. We can by their means in one single mental picture comprehend and condense the miniature representations of more external individuals and genera. A single abstraction may offer the picture of certain attributes that belong alike to the first and last, to the lowest and highest modifications that we know or can conceive in time and space. They may even, by not only proceeding from concrete ideas, but again by a circuit leading to such, facilitate the concrete ideas, the recollections of existing objects.

Nor is this all. If of the different individuals on this globe out of its various elements combined, the elements, on their again decombining, go to higher and more extensive globes, as we have reason to suppose, and there again are recombined in entities more extensive and more perfect, each singly and individually composed of the elements formerly belonging to many distinct individuals and species simultaneous and successive of prior lesser and more imperfect worlds, the concrete perceptions and sensations that must arise in these higher and more perfect individuals, must themselves already only be similar to the abstract ideas of entire genera, such as we conceive here below, as extracted from the concrete ideas of different individuals dispersed over this globe. What at present are only abstractions and generalisations, unlike actual realities, and only founded on vague and indefinite ideas of such, may then only be on retrospection considered as anticipations of those ideas which in a higher globe hereafter we shall receive in the more clear and definite shape of actual sensations from without, and of the concrete ideas by these produced.

Even on this imperfect globe, by the mental organs capable of forming abstract ideas may be conceived many ideas, wills, resolves and reactions outward, which cannot be formed where only arise the organs capable of forming mere concrete ideas.

First may out of them arise a knowledge, not yet arising from the mere concrete ideas of peculiar portions of attributes, as only belonging to peculiar individuals in their capacity as such, but only arising from the abstractions of such ideas of these portions of peculiar attributes of these individuals, in their capacity of portions of more extensive genera, which knowledge is dignified and distinguished by a translation of its name in Latin,—by the name of science; as for instance, when out of the knowledge of the movements of peculiar individual heavenly bodies, we form the abstract idea of the science of astronomy.

Next may out of them arise an abstract idea of applying that abstract knowledge of certain peculiar attributes or modifications of nature to peculiar practical purposes, not yet accomplished by mere productions of nature themselves; of decombining them from the objects to which they belong, and combining them with other objects from which they were separate,—which process we call a process of art; as for instance, when we form the idea of combining with the natural forms of the human limbs, certain metrical movements, which are not suggested by mere nature, and thus invent the art of dancing; or when we form the idea of separating from a plant its filaments, and uniting these in a peculiar tissue, which we call the art of weaving.

Of these ideas of art may arise different sorts.

There may arise ideas of producing from certain external objects and modifications the decombination of certain of the attributes by nature attached to them, and the recombination of these attributes with other objects and modifications, to which they were not by nature attached, and thus, of producing, by means of this decombination and recombination, new forms and faculties not before by nature produced, which are called inventions.

There may arise ideas of producing, through certain attributes, already by nature offering a certain resemblance to other attributes again different from themselves, a still greater intentional resemblance to these others, which when only produced by giving to natural limbs and faculties an evanescent resemblance only to the movements and sounds of peculiar other entities is only called mimicry, and which, when it rises to the idea of producing through certain substances, sentative signs, such as those signs for things and ideas, called words and language, addressed to the ear or the eye, spoken only or written.

There may arise ideas of classification and of method.

It must, however, be understood that between the first origin and formation of the mental organs, through means of which these mental productions or ideas may be afterwards effected, and between the later maturation of these organs, which may first actually enable the ideas to be formed, a great lapse of time, and a long process of successive developments must intervene; and that even when these ideas are formed in the mind, they can only be executed by the body, through dint of instruments called organs of action, which again, from the organs of mind flowing outward, mature at the same time with those of mind themselves.

It must, moreover, be understood, that not only those organs and faculties of mind, by which these combinations of art are conceived, and those organs and faculties of body, by which they are executed, but those very materials out of which they are formed, are still only further developments of nature herself.

The most complex court petticoat, with which a fine lady disguises her natural forms—composed of brocade, of lace, of whalebone, of hair, of wool, of fur, of cotton, of diamonds, of tinsel, of different dies and pigments, &c. must still be composed of materials all drawn from the mineral, vegetable or animal reigns of nature.

This is not all: while brutes, while entities, able only to form concrete ideas, unable to form abstract thoughts, cannot entertain any of those mental feelings, either beneficial in their tendency, such as those of affection, connubial, parental or social,—of friendship, of benevolence, of wish to oblige,—or injurious in their tendency, and called passions, entities able to form abstract ideas, may be made to entertain all these feelings, and from some of them to derive pleasures, and from others pains, mental and bodily, unknown to brutes.

It however must appear that though only in peculiar organs not produced in brutes, can, when matured, arise the faculty of producing abstract ideas, and all the other consequences of these, here set forth, and though of these organs a certain quantum is necessary to entitle its possessor to the name of rational being,—of man,—even in men, formed of materials less or more rich and copious, these organs and faculties will only develope in different degrees.

That as in certain brutes so in certain human beings will first be laid the foundation of organs of sense more fine and more acute than in others; that next in some will, between these organs of sensation and thought, be formed ducts of communication more numerous and more varied than in others; that again, in some these ducts will, by more use, exercise and cultivation, be rendered more capacious, more active and more flexible than in others; and finally, that in some the cerebral fluid, more attracted to the ducts serving to form abstractions than in others, will even, as they form abstractions more extensive, again lose their readiness to form and to retain concrete ideas of distinct individuals.

CHAPTER XXXI.

Every time and place was not equally suited to every sort of combination inorganic and organic, vegetable and animal.

Of the different species of entities especially organic, vegetable only, or also sentient, which were made to arise on this globe, the first individuals were not each able to arise in the same place, or even at the same time with those of each of the other different species.

Whether it be that there already in the atmosphere, and at the surface of this globe, existed elements of sorts and in quantities sufficient for combination in certain species of organic entities, before this atmosphere and this soil were supplied with elements of sorts and in quantities sufficient for the formation of other species, or whether, even supposing this atmosphere and this soil were at the same time and simultaneously supplied with the elements requisite for every species of combination, of some of these sorts the actual combination could not take place until of other sorts, simpler and less complex, the combination had first prepared their bases and moulds, this is certain, that we not only in certain places find, of certain entities organic, vegetable and animal, the substances in such a state,—find for instance carbon or the chief material of vegetables, in such a liquid state of naphtha and petroleum, and in such a solid state of sea-coal, and find nitrogen or azote, the chief material of animals, in such a state of oily and fatty matter, divested of all remains of organization, as to warrant the belief that in those places it lies, not as a substance which has already been organized and has later again been decomposed, but as a substance which has originally been accumulated in masses so dense, so little accessible to any of the finer aerial elements, as never to have with them been combined in entities of an organic sort vegetable or animal; while in other places we find the relics of divers entities vegetable and animal actually combined, so disposed relative to each other in time and place, as to prove that some of them could only be combined and arise, where certain other simpler and inferior ones had been combined, and had arisen before.

Thus we find the relics of many productions of a vegetable description where no relics of any vegetables of a higher and more complex sort yet appear; as for instance, over mere inorganic masses relics of criptogamous plants, where no remains of phanerogamous plants are found;

of monocotyledonous vegetables relics, where no remains of dicotyledonous plants are perceptible, and of different sorts of vegetables relics where no remains of any living entities of an animated species are found.

Thus again we find remains of primeval animals of the lowest order, produced in water, of worms and mollusca, where no relics of animals more rare and complex, produced in air, of insects and birds yet are found: of animals still invertebral, where no remains of animals vertebral yet are found: of animals vertebral of an inferior sort, such as fish and reptiles; where no remains of brutes of higher sorts are found.

We even find traces of a period when no animal higher than reptiles, or animals capable of subsisting partly in water, still existed; but when these latter, not having any part of their substances and materials yet drawn off from them and monopolised by other higher animals earthly and aerial, more complex and more elevated than themselves, attained a development, which has later again ceased; when all those large and monstrous amphibia, since regarded as fabulous, still in reality existed, when the confines of the water and the land teemed with gigantic saurians, with lizards of dimensions much exceeding those of the largest crocodiles of the present day, who, to the scaly bodies of fish, added the claws of beasts, and the neck and wings of birds; who, to the faculty of swimming in water, added not only that of moving on earth but that of sailing in air, and who had all the characteristics of what we now call chimeras and dragons; and perhaps of such monsters the remains, found among the bones and skeletons of other animals more resembling those that still exist and propagate, in the grottos and caverns in which they sought shelter during the deluges that affected the infancy of the globe, gave first rise to the idea that these dens and caves were once retreats whence such monsters watched, and in which they devoured, other animals; and left after them the relics of the havock and devastations which they inflicted on the surrounding regions.

Of these dragons we again find the more deep buried remains, followed later in time and higher place by those of other animals herbivorous and frugivorous more enormous than, but more closely resembling those of the same class, that still subsist on the face of the earth; by those of mammoths, of mastodons, of elephants, of rhinoceroses, of rocs, and of other palæotheria of the beast and bird species, more huge, more generally dispersed over the globe than, but more similar to the elephants and rhinoceroses, and eagles and condors, that still live and propagate.

And of these animals, all still herbivorous and frugivorous, larger and more potent than any still existing, which have since been again all destroyed, we find the last again succeeded by those animals of a carnivorous sort, still existing, but of which the most formidable species are every day more and more hemmed in, and deprived of room to expand and to propagate, by the extension and propagation of all devouring man.

It fares on the waters as on the land: there is no reason that to assert that the ocean was not once peopled with those polypuses, of which Pontoppidan describes the remains under the name of craken; that the Mediterranean was not filled with those cetacea of which the Bible mentions an individual as having swallowed Jonas. But of the one and the other no specimen now remains.

Finally, only last of all, and after many of the largest and hugest of the former species of animals had again considerably diminished, or indeed disappeared, are found the earliest relics of human beings, whom consequently we must suppose only to have risen on the ruins of certain of the former entities, and only to have spread through means of the decomposition and remixture of the elements of a greater number of these former ones.

Nay, if it be true that certain inferior vegetables and animals can only be formed out of, can only live upon the elements exsuded by different parts of prior more complex vegetables and animals, which during their life, or after their death, again are partly or wholly decomposed, it must be evident that even some of the highest individuals in our estimation must have been previously formed as a base and stepping stone to some of the lowest; that only after some of the highest have been previously composed, some of the lowest and most despicable can subsequently have arisen.

It fares the same with space as with time. In certain places we find only elements of peculiar sorts in sufficient quantities for peculiar inferior combinations. In these places the elements whose addition is requisite for combinations into higher entities do not exist in sufficient quantities for that purpose, and consequently allow not these entities to be formed.

In regions to which the sun, the chief source of the elements that form and impress the senses of taste, smell and sight, only sends forth its rays more obliquely and more sparingly, and at greater intervals, bodies both inorganic and organic are in general individually less powerfully knit and combined, less vigorous and less extensive, more lank and inelastic, more insipid in taste, more weak in odour, more dusky in hue, than they are in regions where the sun pours out its elements in greater abundance. It is only as from the opposite poles we approach nearer to the intervening line, that we find enducts inorganic and organic, vegetable and animal, more capable of impressing strongly by their attributes the external sense.

Only between the tropics we find in the mineral world the richest crystals, marbles, porphyries, jaspers and gems—the diamond, the ruby and the sapphire. There only the vegetable world displays its ferns forty feet high, its grasses soaring to the height of trees, its cactuses like columns, its creepers whose tendrils form cables able to support in their fall the stoutest stems, palm trees from whose scaly stalk the feathering foliage only begins to spread a hundred feet above the base; the Honduras wood which cuts up in boards ten feet wide, the banian tree, whose limbs, reverting to the earth from which they rose, spread over whole acres of ground, the banana plant whose leaves singly form a garment or a roof, and other plants whose flowers exceed in size the largest shield.

There only in the animated world arise those corals whose scarlet branches form submarine forests—the chama gigas on whose muscle a whole ship's crew makes a plentiful meal, the pearl shell, the paper nautilus, the diamond beetle, centipedes like serpents, spiders like crabs, lizards like crocodiles, butterflies like birds, snakes able to swallow oxen, the parrot, the peacock, the bird of paradise, the ostrich, the elephant, the giraffe and the tiger.

If, however, in the same way that certain higher productions cannot arise in certain poorer regions, certain poorer productions cannot rise in certain richer regions,—if richer materials as well as poorer ones are inimical to certain combinations—if the rose and the cherry only are found in temperate climes—it is that, as in the combination of entities there enters more of one sort of element necessary to produce peculiar combinations, there must proportionably enter less of other sorts.

Nay, if in those regions in which the external splendour of the vegetable and brute races is carried to the utmost pitch, the faculties internal and external of man are not varied in the same proportion, this proceeds from the regions where certain elements emanating from the sun are each individually received in the greatest abundance, not being those regions where opposite elements are made to meet and to combine in the proportions best calculated to check, to control, to poise and to balance each other.

CHAPTER XXXII.

Gelatine, rete mucosum, external bone and internal skeleton.

I HAVE shown how of all animals were first formed the more vital insentient parts; how on the muscle of these were next by exsudations from within, with new elements from without, superstructed organs of sensation, of which the first external roots were formed directly under the epidermis, and there composing the dermis, became capable, when by elements similar to those of which they first were formed, afterwards matured, of receiving from without of similar external elements impressions, which they carried through nerves to their inner sensitive half, where these impressions produced in the papillæ of actual sensation, first sensations and next thoughts. How between these papillæ of sensation and of thought arose internal ducts of communication, through which the cerebral fluid recombined those thoughts in new ways, different from those in which the sensations first came from without. Passing over all the intermediate periods intervening between the first foundation of these organs of sensation and thought in the fœtus, and their full maturity, I have represented them as actually able to produce the sensations and thoughts, desires and aversions—the wills—for which they had been gradually prepared, in order to bring the view of the first cause and of the ultimate effect nearer.

But I have not yet described what in reality intervenes in the intermediate period between the first foundation of organs of sensation and thought, and their ultimate maturation into the actual present possession of the faculty of feeling and thinking: namely, of the fluid that by going inward formed and matured these organs, a part again being made to recoil outward, and in that direction to form the nerves or ducts, leading to the muscles on which are seated the roots of the papillæ of sensation and thought; and through these nerves or ducts outward remodifying these muscles themselves; and when afterwards sensations and thoughts, desires and aversions, and wills are actually experienced, this cerebral fluid, through these nerves made to flow outward to the muscles, or to be withdrawn from these, causing in them orgasms and protrusions, or depressions and retractions, corresponding with the will.

Had these nerves outward not been formed: had sensations, thoughts, inclinations, and aversions in the mind been produced without the same cause producing voluntary impulses outward, or voluntary retraction from without, no actions could have arisen corresponding with the will. If that will had led to any thing beyond it, that could only have been suffering and misery.

But by the peculiar mechanism of the animal frame, of the very influxes inward that produced the first rudiments of organs of sense, thought, inclination, aversion and will, long before these organs were matured to actual sensation and thought, the partial recoil outward, also, again produced the first rudiments of nerves outward into the muscle, through which the continuation of these effluxes would afterwards, when sensations, thoughts, and wills actually arose, be in the muscle produced orgasms or retractions, which would cause these wills in the mind to be followed by corresponding reactions outward in the body.

When in higher animals, at a later period, we see a skeleton included within their more external parts, and giving to these parts more decided forms and firmness, we are tempted at first to consider this solid skeleton as the earlier frame on which these parts more external and more pliant have afterwards been superstructed.

The contrary is the case: the softer and more pliant surrounding parts are the cradle, the mould, first formed, which in their turn first produce, and in which are first consolidated and moulded the materials whose aggregate ends in a hard bone.

Among the elements from without with the lymph and the chyle introduced in the blood, there is one called gelatine; and after the blood has first exsuded its fibrine, and consolidated this fibrine round it into muscle, it again athwart the muscle itself exsudes this gelatine, which beyond it consolidates into what is called the rete mucosum. This rete mucosum in its turn, where it is more abundant, hardens into gristle, or bone still pliant and diaphanous; except where by the later influx of other elements of various sorts, taken in through the blood, it becomes more dense, more tough, and more opaque.

Animals formed and intended only to continue living in the narrow and tortuous interstices of the earth, where their forms are required to preserve to the last the utmost flexibility, inhale not from air sufficient elements calculated to harden their rete mucosum into any thing more than a mere pliant envelope or sheath: the tissue that lines the rings of the earth-worm, to the last continues yielding. It never hardens into firm plates or stays. These animals have no bones either inside or out.

Even of animals formed and intended to live in water, there are some, such as certain zoophytes, round which the rete mucosum exsuded from them remains a mere porous and yielding sponge, but in most animals either aqueous, or living at the surface of the earth, or in air, the gelatine flowing from their muscle, as round them it hardens into a rete mucosum and into gristle, imbibes from within some substance calcareous or other which renders it more firm and more opaque. Such substances we already see in the coral which other zoophytes form round them.

Insects that live more in air, feed more on vegetable substances, and, from the greater quantity of carbon they take in, exsude into the rete mucosum that covers their muscle more matter ligneous or woody, transform their integuments into shells more light and aerial, of the same nature with the substance of which the wasps form their honeycombs.

In many mollusca and insects, after the first gelatine exsuding from their bodies has hardened round these in a shell or crust, what more afterwards flows out is spun into filaments which fix the mollusca to the surrounding rock, and enable it to ride safe at anchor in the midst of the surrounding waves, or suspend the caterpillar from the twig whence it swings at the will of the surrounding winds. Some animals, such as the silk-worm, wind these filaments round their bodies, and under the concealment of the coccoon undergo their transformations into flies and moths: others, like the spider, weave them into the expanded web of which they afterwards occupy the centre, as a permanent habitation, and there tarry till in the extremities are entrapped the insects on which they subsist.

In these, and in other inferior animals, the first gelatinous matter exsuding from their muscle is no longer made round their bodies to form an indefinite detached lump, or aggregate of ramifications like those of coral, but is, by the resistance and pressure from without, condensed and moulded close to their bodies in as many pieces, separate from each other, placed side by side, as there are muscles from which it exsudes. Asterias and medusas only form round them a continuous bony integument or sheath. Univalves from their body exsude a single ossous tube which lengthens and widens with that body. In bivalves, from the opposite sides of their body exsudes matter which forms into two flat shells or trays, filled with calcareous matter, to the substance of which between the body and the layer of calcareous matter of the year before, every new year adds a new and more extended stratum.

Where animals have side by side a certain number of different muscles, from each of which is poured forth a certain quantity of gelatine, the gelatine of each hardens into an ossous plate, proportionate to the size and shape of the muscle, bounded by the ossous plates formed over the neighbouring muscles, and connected with these by the general epidermis under which all the ossous plates are formed, and which, though connecting them, is pliant enough to yield to the movements, by the muscles given to that armour which protects them. Thus are formed the various pieces of the corslet or coat of armour of insects and crustacea. Thus are their pliant limbs shapened into a capability of performing different movements and actions outward, and of resisting actions and movements from without.

When that crust which, after consolidating and hardening can no longer grow, begins by its stationary size to confine the growing parts underneath, these parts by their pressure cause its different component pieces, only held together by the epidermis over them, to burst asunder, to be cast off, and, from the gelatine which continues to flow out of them, cause to be formed underneath a new coat of armour, roomier and better adapted to the increasing size of the animal.

Nay, when animals, like insects, first only endowed with a form simpler and less complex, requiring movements and actions less intricate, are made, in proportion as they grow, also to acquire a form more complex and more varied, requiring movements and actions likewise more varied, of their first ossous integument or shell the parts are often made, by the forming of a fresh epidermis more extended under them, and by the bursting of that over them, to be, like those of the scarabæus, lifted up without entirely detaching themselves, so as to give room occasionally for this new rete mucosum to extend beyond its shield and to serve as wings. In the chrysalis of the butterfly the first horny envelope is, after a time, made to drop off entirely, and to display permanently to the air its new forms and its new faculties: to turn the entity from a worm, creeping on the solid ground, into an animal rising in the light atmosphere.

I have thus far only described the inferior animals in which the gelatine from within, driven outward, is made to form ossous concretions round the muscle at the surface of the body; but in those animals in whom a pressure from without and a suction from within more considerable would first produce a system vital, muscular and nervous more complex,—in whom upon and round the muscle the internal roots of these nerves would form a tissue or dermis more dense and thick, having nerves more multifarious, prolonged further inward,—the pressure of these ducts inward would also cause of the gelatine exsuding from the muscle a greater part to be driven inward, and to consolidate in ossous concretions in a different direction.

Already in many mollusca and insects, in which the bulk of the gelatine is still driven outward, and made to form an ossous sheath at the surface of the body, of that mucilage some lesser part would also be driven inward, till, meeting in earlier formations unconquerable obstacles, it became by these resisted, and, between the pressure from without and the counterpressure from within, arrested, and made to accumulate and consolidate in various ossous lumps at a distance from each other.

Such ossous lumps we already find in oysters, under the name of pearls, and in most crustacea and insects.

As the nervous system became more developed—as the resistance of the nervous cord from within, by anticipation already called spinal, caused the gelatine, from without by the dermis pressed inward, to be internally resisted by this cord, it would by the same be moulded round its surface in as many different rings or sheaths as there were different distinct muscles from which it was poured forth; and these rings, ranged by the cord that run through them in a regular series, would compose a column protecting the spinal cord wherever this latter entered it; and which column would give greater firmness to the parts around, while by its articulations it still allowed these parts to obey the impulses and movements of the nerves.

The rings of this ossous sheath are called vertebræ, and where in animals the body is sufficiently ample, the materials of these rings are again extended and elongated in further excrescences called ribs.

Over the body, and in the face, the muscles

the ossous concretions of the lower and
r jaw; and behind these anterior muscles
ther muscles of the head form, over the
which is only the ultimate elongation of
erves collected in the spine, the ossous
of the skull. So much is the convexity
tain of these plates produced by the pres-
wards of the muscles outside them, and so
is it counteracted by the pressure from the
withinside outward, that where an eye is
ost, the socket becomes, by the pressure
he brain within, obliterated. On the other
the skull of an idiot, in whom the brain
s less developed and less forcibly pressing
d, remains less ample and extended than
f entities in which all its organs receive
ull developement.

er ossous concretions would be formed in
eral extremities anterior and posterior: in
ns and legs, the fingers and feet; and
he bones in the posterior limbs would be
ted with those of the spine by the inter-
plates of the pelvis, the bones in the an-
limbs would be connected with the same
shoulder blades.

erent bones arising from different muscles
y gradual growth, extension, and approxi-
n made in different ways to join on to each
to press within or lap over others, or to
h others gradually connected in one single

continuous mass; and when, by the efflux of the cerebral fluid through nerves outward, which is accompanied by a feeling of desire, or by the retraction of the cerebral fluid, already through the nerves outward poured into that muscle, which is accompanied by a feel of aversion, these nerves in the muscles produce movements of orgasm and protrusion, or of depression and retraction, these muscles communicating these movements to the bones, formed upon or within them, would cause these bones to be in their turn drawn out of, or reinstated into their pristine position, and by their reaction render the movements and actions of the muscles, themselves limber and soft, more firm, more precise and more definite; and as the muscles and the nerves were more multifarious and more closely knit, and as the latter offered to the gelatine flowing from the former a resistance more diversified and more powerful, the bones, moulded in forms more varied and more complex, would become capable of receiving from the nerves and muscles movements more fine, varied, complex and definite. In certain animals not only the gelatine given off by the blood, but some part of the blood itself, would later be driven to, and in the bone be made to form vessels; and, through the medium of these vessels, increase and accelerate the nourishment and growth of that bone.

In some animals, such as crustacea, from the muscles of the stomach flows out a gelatine, which in that very stomach already consolidates into a sort of teeth. In later and higher animals a more vigorous pressure outward makes that gelatine rise to and only protrude from the jaws, and these animals form teeth better fitted to tear, to divide, and to bruise the solid substances and bodies taken into the mouth, before they are driven down into the stomach; and it is not singular that the stomach, being the earlier and more fundamental part out of whose later extension and growth arises the mouth, when in that mouth the gelatine is moulded into teeth, the pressure from the stomach should, with the counterpressure from without, mould those teeth in the shape best calculated to mince the elements from without, taken in for the further support of that stomach; and that from the mere inspection of the teeth we should be able to infer whether an animal is herbivorous, carnivorous or omnivorous.

In birds the gelatine exsuding from the jaw is only moulded into a continuous beak or bill.

In human beings, as the jaw enlarges, the first set of teeth, already very close, after a time become too condensed to be able to receive the further gelatine exsuding from the muscle. This gelatine then, arrested by these teeth, accumulates under them and forms new teeth, which in time push the former ones out of their sockets and replace them. As in age these teeth shrink they fall out of the gums, in which then they are by no fresh gelatine replaced.

Even in most of the animals in which a portion of the gelatine flowing from the muscle began to be driven inwards, and to be compressed into the internal bones of a spine and others, of this gelatine another part would still continue to be poured outward, and, over the surface of the muscle and dermis, and under or athwart the very pores of the epidermis itself, with external elements to be mixed, combined and consolidated in external concretions which, according as they were by external pressure left to remain more conglomerate, or were made to become more divided, end in a single continuous shell, or in a number of more minute and partial plates, scales, or fibres, called fur, wool, bristles, hair or feathers.

Already some mere insects, such as moths and butterflies, have hair, down and feathers proportionate to their diminutive size. The fish in general have scales which lap over the root of those underneath, and have their own roots concealed by those that grow over them; many amphibious animals have plates which fit on to each other; and only in a few of the tortoise species is the gelatine so entirely driven inwards, as to leave them entirely destitute of external shield and basin.

Most quadrupeds still have a thick coat of fur, wool, hair or bristles. In most birds the finer texture of the gelatine from within, and the more divided pressure upon it of the air from without, makes these bristles ramify into feathers. Those of the cassowary remain fibreless.

From those ridges and extremities of the body, from which flows out a greater abundance of gelatine, it consolidates into forms more extended and more elongated, as in fishes in the fins of the back and belly, in beasts in the hair of the mane and tail, and in birds in the plumage that extends from the pinions and that grows from the rump. In man, in whom more of the gelatine is by suction carried inwards, only enough is left going outward to form a dense covering of hair to the cranium and to certain other more juicy parts of the body, and over the remainder only to leave a hardly perceptible down, though so near to the formation of bristles still remains that very down, that certain individuals of the human race have been seen entirely covered with the spikes of a porcupine.

In higher animals, not only from the stomach is driven to the anterior extremity or mouth the torrent of gelatine forming the teeth, but to the lateral extremities, anterior and posterior, are driven the other torrents of gelatine, which with elements from without combine and consolidate into the hoofs or nails. These nails, like the teeth, proceeding from the stomach, have the same analogy which the teeth themselves have to the wants of the stomach. In herbivorous animals they are obtuse and clumsy hoofs only, capable of affording mere support; in carnivorous animals they are nails, capable moreover of prehension and of tearing; and in man, endowed with omnivorous faculties, they preserve the medium between the two extremes.

In some animals from other parts still exsude excrescences which become horny; and like the scales, hair and feathers, in many animals these horns after a time become too dense to admit of further influx of the gelatine which continues exsuding from the body. It then accumulates under their roots, there hardens, pushes them off, and replaces them.

We have seen that the very first organized and living entities already from within drove out a siliceous matter, which between and over the various organs hardened into a transparent and porous integument, called epidermis, through which the later inhalations entered and exhalations issued; and where through the pores of the first epidermis flow out such exhalations as are formed into further solid excrescences, a new sheath of epidermis ever again covers these. In inferior animals, who take in much of this siliceous matter, part of it on exsuding elongates in the wings, which we see in gnats, flies, bees, beetles, and even bats.

This integument, which over the eye assumes the name of cornea, to the last continues to remain to the different organs, and to the whole surface which it covers an ægis which, unless force is used, only lets of external elements as much penetrate athwart it as benefits the parts within. As it is exposed to more friction and resistance from without, it becomes denser, harder and more capable of resisting that friction. In old age, when the parts within shrink, that epidermis often sits over them in wrinkles.

CHAPTER XXXIII.

Excrementitious substances.

Already of the various elements that are radiated through the atmosphere, different sorts sucked in by different plants, are by these vegetables condensed in oils, essences and balsams, sometimes very sweet or pungent, sedative or stimulant, which again from their axillæ, leaves, flowers and other parts, are driven out and made to exhale.

In smaller animals, especially of an aerial sort, similar elements are absorbed and are again from similar parts in a more condensed state emitted. Already in water the sepia thus takes in the substance which, by the inky hue it contracts when in the agitation of the animal's flight it escapes, covers its retreat. But especially insects when, issuing from the egg they rise in air, inhale a variety of such substances. These substances when in them they accumulate in great quantities often acquire a powerful pungency. They form vessels, and through these vessels, according as the pressure is greater forward or backward, they are again let out through the proboscis or the opposite extremity in the form of a sting. When the animal is irritated this tube or sting stiffens, pours out its contents, and when in contact with softer bodies, in them makes a wound through which those contents are made to flow in that body. Innocuous to the body by which they were attracted, and in which they were made to accumulate, they generally by their pungency act as a poison on the strange body in which they are introduced, and nauseate more senses than one.

Thus the fly, the mosquito, the bee, and the wasp have their virus and sting, of whose use in hot weather they become more than usually liberal. The bee often from the flowers it sucks brings home this virus in the shape of poisoned honey. The beetle and the bug cause this venom to inflame the swellings their sting produces; and the ant secretes an acid so powerful, that when the animal attempts to cross a line of chalk, the effervescence it causes in this line singes its own legs. The spider with its effluvia first torpifies the fly, which afterwards it devours. The yulus, when alarmed, pours forth emanations so pestilent as by their mere odour to repel its pursuers, and the bracchinus crepitans of these emanations lets out entire volleys. Nay, the females of the fire-fly and glow-worm of the very light and colours they imbibed imperceptibly during the daytime at night again emit part in a more condensed and visible shape, and thus hold out a beacon to the males that pursue them.

Certain fishes and reptiles still in the same way cause the elements they take in to be by powerful explosions let out. This we see in the torpedo and the gymnotis, which, of the electricity they inhale, when irritated let out such quantities as cause violent shocks.

Bating these few exceptions, even in the regions where the sun sends forth its various elements in the greatest abundance, toads, vipers, and other small reptiles are the largest animals that imbibe certain elements in a shape so condensed as on emission to become venomous; larger animals, no longer wanting these means of defence, no longer on ordinary occasions possess them: only when by extraordinary excitement and irritation their fluids are curdled and decomposed, they acquire that fatal power, sometimes felt from the bite of a rabid dog or cat.

On the different ways in which the elements from the blood exsuded are under the transparent epidermis brought in contact with the rays of light from without, and are with these rays recombined, depend the hues which through the cuticle the various integuments of the body itself —the scales, hair, plumage, or skin exhibit. To such causes is owing the opalescence of the oyster shell, the metallic lustre of the fish and beetle, the velvet hues of the butterfly, the more modest tints of the beast, the spots of the tiger, the stripes of the zebra, the azure and the scarlet reflexes of the bird, the mock eyes that are strewed over the tail of the peacock, and the colours that mark the iris in the real eyes of all animals. To such also are owing in the human race the varied hues of the copper-coloured Caraïb, the olive of the Malay, the black of the negro, and the rich complexion of the European.

Where in certain animals, such as mice and magpies, rooks and rabbits, nay certain human beings of races naturally dark, peculiar individuals remain albinos, it is that the elements which produce colour are not by the blood exsuded in sufficient quantities; and where with age the parts of these animals turn gray and white, it is that these parts, shrinking and dry, no longer from within afford transit to those elements.

CHAPTER XXXIV.

Instruments of sound at the outside, and instruments of voice at the inside of the animal frame.

Besides the organs of voluntary movement, through means of which animals re-act more directly on external objects inanimate and animated, some animals have organs of movement which produce sounds, through the medium of which they act more circuitously on other animals only.

The animals only destined to live in water—those only able, from the density of the element forming and surrounding them, even to hear the vibrations of sound very indistinctly, have not yet in any of their organs sufficient elasticity themselves to produce vibrations of sound. Nearly deaf, they are entirely dumb. Fortunately they want not those organs of sound they possess not. The inferior sorts are hermaphrodites; and in those in which the sexes are divided, the male, when moved by sexual desires, need not seek the female, nor make her proposals. She conceives and lay her eggs without his co-operation. He is attracted by and fertilises these eggs without her consent.

But already insects, more aerial in their substances, derive from the element in which they live that greater elasticity which produces in them external husks and integuments hard and dry, capable of strong friction and vibrations; and the same superior elasticity which enables them to produce vibrations of sound more distinct, also enables them to be by such vibrations, when by others produced through the medium of air, more distinctly affected: enables the females to receive, through their organs of hearing, excitements similar to those which made the males produce the sounds arising from such excitements. Without yet knowing whence the call of the males proceeds, the females, by the emotions it excites in them, are made to approach and to answer that call. The mechanical and monotonous sounds produced by external instruments, however, still only resemble the harsh and unmodulated clickings of a clock, gratings of a file, or grindings of a wheel: they are incapable of modulation.

Higher animals, who had softer and more pliant integuments, would no longer only be able from their outer surface to produce mere mechanical noises: they would, when in moments of agitation they emitted from their internal lungs, through their larynx, mouth and lips, columns of air more copious than usual, with the muscles of the throat so strike that air, as to cause from within those vibrations of sound deeper and more varied, called voice. Yet in reptiles, that voice itself still has little modulation; that of frogs is only a hoarse croaking, that of serpents a harsh hissing.

In beasts endowed with muscles of throat and mouth more elastic and complex, and capable of movements more varied, the voice already becomes in its intonations and expression more forcible and more diversified.

But peculiarly in certain of those more aerial animals called birds, that greater quantity of air, at the same time that it renders their feelings more acute, renders their muscles of movement so much more elastic and flexible, that, when through their sympathetic nerves the cerebral fluid acts on their lungs and throat more finely organised, through these parts are produced in the male sounds more distinct, more varied, more strongly affecting, and more instantaneously responded to, by the female.

Some birds are even by the sounds emitted by other entities of their species so strongly impressed, that these sounds excite in their organs of voice movements calculated to produce similar sounds. The bullfinch still only produces such imitative sounds as are inarticulate. The parrot and the magpie imitate articulate sounds.

In the human being different mental emotions, acting differently on the organs of voice, through means of these organs first produce different natural and inarticulate cries. When human beings first begin to feel desires and emotions, at once individually too feeble and too indefinite, and collectively too complex and varied, to be expressed by these mere natural cries, their powers of abstraction and reason suggested to them the idea of inventing and composing other noises no longer produced by the mere solicitation of nature, but by the instigations of art, more complex and varied than the former, as the readiest mode of representing these emotions and desires, and that which arose most naturally out of inarticulate cries themselves. These signs they made intelligible to those that were to understand them by accompanying gestures. Man prompted by lust would then, instead of knocking a woman down, and ravishing her by force, ask her consent to his wishes. The infant prompted by hunger would then, instead of grasping the mother's nipple, request of her to gratify his appetite, do the same, by sounds which would elicit from her other sounds signifying that she gave or refused the boon demanded. Thus would begin artificial and conventional language.

Thus only by elements from without made to meet, to combine, to be by other later elements from without again decombined and driven out, and in their way outward with new elements from without, over the former combinations made to meet, to combine and again to flow inwards, are life vegetable and animal, sensation, thought, will, and voluntary reaction outward on external surrounding objects and modifications first produced, and next made to increase and to develope.

Helvetius has supposed that the preeminence of man over brutes only arises from the superiority of his external organs of action; that, for instance, only from the finer organization of his fingers he is able to knit. Helvetius seems to have forgotten that Voltaire and Newton have produced works of intellect with which the agility of the fingers had nothing to do; and that where the agility of the fingers contribute to the superior execution, the mind must first have produced the superior invention. Nay that it is only out of the later reaction outward of the superior organization of the internal instruments of the mind, that ultimately arise the superior executive powers of the body.

CHAPTER XXXV.

Although every organ has its definite prior causes, every organ seems not yet to have its definite later purposes.

Notwithstanding we generally find in most animals, for the peculiar purposes wanted the peculiar definite means also provided, we often find the means not sufficiently developed to produce the purposes seemingly intended. Thus there are many brutes which with the rudiments of legs and wings never have these abortive organs sufficiently developed to walk or fly. Cetacea never acquire anterior extremities sufficiently elongated to move on dry land; and in pinguins the pinions do not develope sufficiently to buoy them up in air. We must, however, suppose that even in these animals those parts already answer certain purposes of utility and benefit, unknown to us, though they cannot yet answer those ultimate more evident purposes for which according to our ideas they alone seem destined.

Nor is in animals each peculiar organ yet so pointedly destined to a peculiar purpose, but what in different species of entities the same sort of organs serve for different purposes, and different species of organs serve for the same purposes.

Ascidia, for instance, through their gills take in both air and solid food: fishes only through their gills take in air, and leave to the mouth the task of taking in the more substantial liquids and more solid food. Reptiles, beasts, and birds on the contrary take in not only solid and liquid food, but even air through the mouth, and only leave the contraction of the gills, which form the eustachian tube and ear, to take in the vibrations of sound.

In many mollusca of the rete mucosum the elongation forms sails which, puffed up by the wind, assist the animal to cleave the waves. In many insects this rete mucosum forms wings able to buoy them up in air. In fishes this rete mucosum again forms the fins, and in certain of the quadrupeds, called bats, it equally forms the wings.

In fishes and in birds the nether extremity or tail elongates in a rudder to steer their course through water or air. In the beaver it becomes a mason's trowel; and in the monkey a fifth hand, with which to grasp branches and boughs.

These are shifts of nature, originating in the imperfections of this world, which probably in a higher and more perfect globe will no longer be necessary.

CHAPTER XXXVI.

Organs of sense in brutes more acute than in human beings.

From the peculiar construction of brutes those of each species seem to have the organs of some peculiar sense more developed and more acute in its faculties than are the corresponding organs and faculties of man, precisely because each species of brute still has the organs of the peculiar sense it excels in less interfered with by the organs of other different senses, and by the later organs of the mind, the formation of which draws off materials from the formation and finish of those of the external sense,—because the brute not yet having the materials of organs of sense and mind so much divided and diffused between different sorts of organs, those of each sort which they possess, seem susceptible of receiving impressions more forcible and more lasting. External modifications which glide over the sense and mind of man unperceived, penetrate deeply into those of brutes, and make on them a profound impression. Thus the inferior brutes seem more acutely to feel the impressions of electricity: most of the higher animals seem more acutely to feel certain impressions of smell, proceeding from the elements that enter greatly in their first composition, and that are most necessary for their further support: many birds have organs of hearing more delicate: and certain of the higher beasts and birds have organs of sight more acute and more quick. The hawk sees in the daytime objects more minute and more distant than man sees; the owl and the cat see better at night; and the monkey seems to possess organs of sight at all times susceptible of impressions more intense and more rapid. It is through these only that he is led to perform those movements, which we take for intentional mimicry.

In general, of all brutes the higher classes of monkeys seem in internal organs of intellect, and in external organs of voluntary action, to approach nearest to human beings. The baboon already can stand and walk erect, and resembles man most in his gait and actions. Still as his mind within developes not yet in organs and faculties of reason, his body without developes not yet in those organs and faculties of voluntary action, which only grow out of organs and faculties of abstraction. His body still is disfigured by an enormous belly: his face, whether seen in front or in profile, still has features little marked, little distinct, little expressive. His extremities are still deprived of divaricating muscles. He cannot bend his arms separately either backward or forward. Able only with his limbs to hug, he cannot embrace or encircle an object. In his hand he cannot oppose the thumb to the fingers. Allowed, consequently, only to grasp firmly a cylindrical body, a stick, he can neither point to a distant object with a single finger, hold a ball, inflict a pinch, nor play on the piano or harp. His legs and feet labour under corresponding inabilities. Able to crouch, to fold his nether limbs together, he cannot divaricate, expand, or cross them, so as to bestride a horse or cut a caper. His feet have no instep, no heel, not even a sole capable of resting fully on level ground. He is more fit for clambering on trees than for walking on a plane surface.

Thence only when secure and at age, he assumes the erect posture of man, as an occasional indulgence. As soon as pursued he forsakes his more imposing attitude, drops the man, falls on all fours, and scampers away the brute.

Of powers of voice he has none. As if afraid to render the resemblance to man too great, and too liable to confusion, by giving him what the parrot already possesses, nature has denied him that boon. He can only bustle, grin and chatter. In vain does he move, act, dress, and eat like man. If he attempts even to cry, the air driven out from his lungs is again lost in his larynx: he remains mute.

Not so well proportioned, or so handsome as man, he labours under the additional disadvantage that other brutes are only in their forms and faculties compared with lower brutes, to which they appear superior; while he, from his near approach to man, is compared with man only, and therefore appears inferior, deficient and positively ugly.

CHAPTER XXXVII.

Gradations in the superiority of the natural organization of human beings over that of brutes.

I HAVE already early in this work stated that even Genesis, so far from opposing favours the belief that besides the human race, of which the Bible gives the history, as having been the most favoured by Providence, there arose other inferior human races, wholly distinct from the same; that peculiar regions had, like their peculiar vegetable and brute races, their peculiar races also of human beings, particularly suited to them; and, in proportion as they were more particularly suited to them, in the same proportion also less suited to other regions, again very different from the former in climate, in temperature, in soil and in situation.

In fact, we cannot help supposing that, if in every climate and region the first component elements of human beings have been diffused through the atmosphere, and spread over the earth in sufficient quantities, as they seem to have been, afterwards to support the number of human beings which we actually have seen covering this earth, these elements must at first, and while yet unappropriated to such beings, have [illegible], and without miracle, been made [illegible] [illegible] [illegible] [illegible] into the first [illegible], and [illegible] [illegible] [illegible] successive developments [illegible] [illegible] [illegible] [illegible] [illegible], and that it only [illegible] of human beings, as of vegetables and animals, [illegible] [illegible] had been thus spontaneously [illegible] [illegible] primary human individuals [illegible] [illegible] [illegible] of such beings became [illegible] [illegible] [illegible] sufficiently rare and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] into new individuals [illegible] [illegible] [illegible] [illegible], medium [illegible] [illegible] [illegible] [illegible] and more distantly [illegible], [illegible] [illegible] human beings already existing.

[illegible] [illegible] [illegible] [illegible] and thus rational [illegible] [illegible] [illegible] [illegible] of the number [illegible] [illegible] [illegible] beings, wholly different from [illegible] [illegible] [illegible] [illegible] peculiarly adapted to the [illegible] [illegible] [illegible] [illegible] in which they [illegible] [illegible] [illegible] still prominence on this globe.

[illegible] from each other and

liarities, internal as well as external, some of woolly-haired negroes, others of lank-haired Calmoucks and Malays, others again of copper-coloured Americans, as different from each other in their inmost organization as in their outermost hue—in their mental capabilities and disposition as in their bodily frame and constitution; for if the subsequent deviations from their original abode and mode of living had alone been capable of producing in them such subsequent deviations from the original type, other still later returns to the original situation and climate, would also alone again have been able by degrees to bring them back to their original type; and of this occurrence we have no example; this event never happens.

No race of negroes has ever in any of the regions, which seem peculiarly appropriate to the production of whites, by any number of intervening gradations been, through the mere influence of the climate, the temperature, the mode of life, the diet, or any other cause short of the repeated crossing of breeds—the repeated combination of elements of the black, with elements of the white species—been made to pass over into a white race.

Without that condition, even in Lapland negroes still only propagate negroes, and on the coast of Guinea Samoyedes still only propagate Samoyedes, as long as the current of propagation

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in
[illegible]

[illegible] to the soil, and [illegible] [illegible] [illegible] the successor of an [illegible] [illegible] [illegible] the races, indigen [illegible] [illegible] [illegible] the modest extremes [illegible] [illegible] [illegible] [illegible] from [illegible] [illegible] [illegible] [illegible] themselves in [illegible].

A [illegible] [illegible] the various races of me [illegible] [illegible] [illegible] [illegible] a single couple, [illegible] [illegible] [illegible] [illegible] a single origin [illegible] [illegible] conventional language, at least [illegible] [illegible] [illegible] [illegible] a miraculous [illegible] [illegible] [illegible] were subsequently ma [illegible] into different families. The races rem [illegible] [illegible] [illegible] [illegible] more in a st

But the reverse of this is precisely what takes place. In the widest regions, the races most savage, least emerging from a state of mere nature, are precisely those of which the smallest tribes, different from each other, each have their artificial and conventional language, however poor and restricted, most different in its very roots from that of each of the others; most unintelligible to each of the others; most strongly proving that in its origin it was different from that of each of the others, and that of course the origin of each tribe itself was different and distinct from that of each of the others. It is only as races, by spreading more, and becoming more civilized, approach and blend more with each other, and more interchange inventions, that with these inventions they also more borrow from each other more of the representative signs or words, by which their ideas, notions and possessions are represented;—that their languages, different in their first roots, in their later superstructures become more assimilated.

Some savans that have yielded to the necessity of recognizing a number of human races, distinct and different from each other, have yet limited the number of these: Linnæus to five, Dumenil to six, Cuvier to three, Desmoulins to eleven, Bory de St. Vincent to fifteen. But it is clear that these limitations cannot be founded on just grounds; that as soon as from the consideration that every region would, as well as of vegetable and brute productions, of human races also have its appropriate sorts, produced by the very indigenous elements of the region, and consequently peculiarly adapted to the same, and as soon as we prove by experience that such must have in reality arisen, we must also believe that in every region these have arisen in proportion to the richness of the atmosphere and soil; that thus, while in soils and atmospheres very poor and sterile, primary individuals arising spontaneously out of the elements of the soil, would only have arisen at such great distances from each other, out of elements so differently modified, and in such small numbers, as to render it possible of their later descendants to pronounce which could, and which could not, have arisen out of the same primeval couple, in other soils and atmospheres very rich and fertile, primary individuals arising spontaneously out of the elements of the soil, would have arisen so near each other, out of elements so resembling each other in their modifications, and in such great numbers, as to render it impossible of their later descendants to pronounce which must have arisen out of the same identical primeval couple, and which need only have arisen out of some other primeval couple resembling that first.

We may thus suppose that on this globe every nook and corner, containing a sufficiency of the elements necessary to combine into the first embryos of human beings, has, where these were approximated, produced out of them the sort of beings suited to the soil and climate; that, if there were not elements sufficient to support and increase all those individuals first formed, some have again subsequently been for want of support condemned to perish, and that others have been enabled to increase and to propagate.

As of monkeys the higher sorts seem only the last and highest of brutes, produced prior to human beings, so of human beings themselves some species seem only the rude sketch of that ideal which nature has reached in others; but what may at first sight seem extraordinary is, that precisely in the latitudes in which naturally arise the highest of brutes—the orang-outang, or wild man of the mountains—namely, the regions of Austral Asia—seem precisely to have been those in which the human race itself remained lowest and least perfect in body and in mind: as if in those regions nature had wasted so much of its richest elements on the brute creation, as to have had but little left to expend on the still higher human race.

Of the different human races once spontaneously produced, many have since probably again been entirely destroyed, whether in their first infancy, or at later subsequent periods, by the fury of the elements, the ravenousness of wild beasts, or the rage of other human beings themselves, of which the higher races, as they more extend and want more room and substance, generally end by destroying the lower tribes, and ultimately leave no trace of these.

Of the latter, however, there still are enough left to justify my hypothesis, and of these I shall describe a few by way of example.

CHAPTER XXXVIII.

Varieties of human races.

In the inland fastnesses of Borneo and Sumatra, and over the islands of the Polynesia, still rove, perhaps soon entirely to disappear from the globe, tribes of which the resemblance to the baboon is most striking, the superiority over the brute, in mind and body, least perceptible. In them, of all human beings, the organs of vitality most early and fundamental—those named abdominal—still present the greatest expansion; those of reaction and movement, superstructed on the first, still display the least possible development and finish. The external seats of those lower senses which still remain most directly connected with the wants of the stomach—the tongue, the jaws, the lips and the nostrils—still preserve the most disgusting amplitude, openness and spread; the organs of the higher senses, still often exhibit an equally disagreeable and repulsive obliquity and want of room. The face, from a preposterous width above, terminates abruptly underneath in a sharp, cheekless, chinless point. The organs of intellect still appear in their narrow cramped receptacle wholly undeveloped. Of the rude ill-formed skull the anterior part—that which, in proportion as it is better arched, gives earnest of organs of thought more expanded—is still so low, so narrow, so depressed, that it can hardly be said to form a distinct forehead. The small deep sunk eyes, like those of the baboon, still keep constantly vibrating in their narrow sockets. The flat, wide, staring nostrils, are scarce by any thing but their yawning orifices distinguishable from the pouches more prominent than the nose, over which they are spread. The skinny chasm of the enormous lipless mouth is armed with teeth long, projecting and wide apart, like the teeth of a saw. Of chin there is no sign. The face, hideous when viewed in front, is not less frightful when seen in profile; its greatest prominence is in the region of the mouth. The head, sunk between the raised shoulders, has not room over these to turn sideways. A trunk of enormous bulk supports arms meagre and deformed, of a finny shortness or uncouth elongation. That trunk moves on thighs and legs short, bowed, crooked and calfless. These supports in their turn are ill at rest on feet flat and square, deprived of instep and of heel, and more calculated, by their want of well-formed sole, to entwine themselves round branches than to walk on level ground. The utmost height of these misshapen mortals in general scarce reaches four feet nine. Their ill-marked muscle is hardly discernible athwart their coarse dusky hide, as distant in its hue from a fine glossy black, as it is from a clear transparent whiteness. The skin is frequently covered with irregular patches of wiry hair or bristles. Their limbs seem unhinged, their movements performed by abrupt jerks. They crouch rather than they sit; they climb better than they walk. Their features have not yet a finish sufficient to mark the distinction between youth and age. In childhood they already look decrepit. Nor do their countenances yet possess sufficient flexibility to mark the transition from calmness to irritation. Little sensible to emotions even of physical pleasure, they are less alive still to feelings of bodily pain. They undergo the greatest hardships without being by their sufferings stimulated to mend their lot; they feed without repugnance on the coarsest garbage; encounter without nausea the most disgusting smells; are inaccessible to any pleasures of the ear or eye; have little memory, and less imagination. They seem incapable of reflection on the past, or of foresight into the future. Unmoved by any prospect of distant benefit, undeterred by any threat of remote injury, they are never seen to express joy, or to denote grief—to laugh or to cry. Only accessible to hunger, while that feeling pinches not their vitals past endurance, nothing ruffles their apathy. Like the brute they are, while in a state of repletion, wholly incapable of providing for the hour of want. Unfeeling for themselves, they cannot be expected to sympathise with the feelings of others. None yet has a wife or a child he calls his own. The female, wooed with a club, when from a means of pleasure she becomes an incumbrance, is by that club despatched. The offspring is left to shift for itself.

Cruel, cowardly and credulous, they are void of curiosity and inaccessible to wonder. Nothing occupying their thoughts sufficiently to become familiar to them, nothing can seem strange. They show no mental faculty beyond that low cunning, already by man attributed to monkeys. When inveigled in the trammels of civilization, they only labour to effect their escape. Incapable of inventions of art with which to supply the deficiencies of nature, they possess neither utensils nor arms. Inland they feed on the grub that crawls forth from the earth: near the seaside on the oyster left exposed by the surf. They go completely naked: they have no permanent abode. In the daytime they prowl about in perfect solitude, at night they creep under the sand. Their speech consists in a few hoarse croakings: but by men who have no ideas, no feelings to communicate to each other, even these are seldom uttered. If clothed by force they tear off their apparel. If caught they try to get loose. The best treatment cannot tame them. When detained they soon, without apparent grief or pain, pine away and die.

Of the New Zealander the skull presents a texture so coarse, a form so contracted, so similar to that of the orang-outang, that anatomists have considered him as the connecting link between the monkey and man.

From the Andaman islands in the Indian Archipelago were once brought away in an Indian junk two middle-aged savages of a peculiar tribe, black and woolly-haired, the tallest of which scarce reached four feet seven, and only weighed seventy-six pounds. Protuberant in the paunch, stunted in the extremities, of voracious appetite and cannibal propensities, climbing on trees as nimbly as quadrumana, diving under water as readily as ducks, heavy and dull in intellect, and, when by themselves, setting up a cackling like turkeys, they only appeared seldom even in their guttural hiss to converse with each other.

In the interior of Luconia and throughout the Indian Archipelago there are vestiges of a black woolly-haired race of pigmies, incapable of the least approach to civilisation, unpossessed of any permanent abode, and when caught, however well used, either soon effecting their escape, or pining to death. Of these the major part have, by a different race of a brown hue, with long lank hair, and endowed with superior mental capacities, found in the same regions, been hunted down, or forced to fly to inaccessible fastnesses, where gradually the race melts away.

In New Holland and in New South Wales, almost every tribe of natives, however small, has an idiom of its own different from that of the neighbouring tribes, and only consisting of a few sibilating sounds, unintelligible out of the tribe. Of these tribes some are hideously ugly. They have noses quite flat to the face like those of brutes, or only noseless nostrils very wide, which entirely want all distinct projection. Their eyes, very close to each other, and deep sunk in the head, constantly vibrate like those of the monkey. Their mouth is extravagantly wide and prominent, their body clumsy and ill formed; their arms, almost fleshless, are of enormous length: their legs equally ungainly; and a rough wrinkled black skin seems ill to fit the ill-limbed body. They live upon ants nests, wild honey, roots and berries: at night they creep into some hollow tree. The males destroy the females, and the females their offspring, when tired of the incumbrance.

Once from the interior of Africa was brought to the West Indies a whole cargo of captured negroes, so inferior in organization to the general average of blacks, so hideous in face, so misshapen in figure, so short, so deficient in whatever distinguishes human beings from brutes, that they could not find any purchaser. They resembled the natives of Old Calabar, residing not far from the coast of Guinea, who have foreheads and chins almost obliterated; cheeks or rather pouches projecting beyond the nose, wide, prominent, lipless mouths, armed with long sharp tusks or teeth standing out; eyes almost in contact with each other; bellies that hang down over their thighs; a chest very narrow, arms of prodigious length, thighs extremely short, spider legs void of calves, and splay feet as ill-fitted to stand firm on even ground as those of the neighbouring monkeys.

Near the Cape, intermingled with the higher race of Hottentots, are the Bosjes-men, of which the males scarce attain a height of four feet six inches, and the females of four feet. They become decrepit and wrinkled at what among whites would scarce be deemed a mature age. Their noses are flat to the face, their eyes in constant motion like those of monkeys: from their broad cheek-bones their faces taper down to a sharp point: their hair is woolly, their coarse brown skin usually besmeared with grease, and their body begirt with the decaying entrails of the animals they have devoured. The females in some parts of their frame are meagre and stunted, in others they exhibit an exuberance similar to that of the Caramanian sheep. Their posterior excrescence is often balanced by a natural apron before similar to the pouch in which the kangaroo nurses its young. They sleep, seldom two nights running, in nests which they contrive in the bushes; are equally strangers to the use of fig-leaves and of fire. Apathic but fearful, and not even possessed of the intelligence required in slaves, they spend their time either prowling about in perfect solitude like wild beasts, or crouched like monkeys in a circle, exhibiting an unmeaning grin or an inarticulate chatter.

But enough of the very lowest specimens of the human race, which every where exhibit a great sameness both in their physical drawbacks and moral deficiencies. Even in certain negro races of a very superior cast to these, while there still remains, as in certain brute races, of the olfactory, optic and fifth pair of nerves, a development much greater, a power of conveying sensations of smell, sound and sight, in certain respects much more acute than is found in higher human beings, there still remains to the monkey a nearer affinity in other organs and parts internal and external;—in the marked contraction and want of room in the brain, thickness of the skull, height and size of the flapping ear, yellow opacity of the eye-balls, incessant vibration of the eyes, and depressed expansion of the nasal cavities over hollow cheekless pouches; in the skinny projecting mouth, armed with wide rows of threatening teeth, under which dives away a chin almost obliterated; in the angularity of the shoulders, length of the fore-arm, square obtuseness of the hand, crookedness of the thigh-bone, gibbosity of the tibia, height and smallness of the calf, flatness of the heel and instep, uneven bearing of the sole both longways and broadways, spareness of the muscle, duskiness of the skin, and tendency of all the parts to a leaning forward, in its turn producing a preference of a crouching to a sitting posture, and a superiority in the movements of diving and of climbing, over those of walking and running, greater than are possessed by higher races. Most negro tribes may still be said to display in their forms a want of fulness, in their movements a want of precision, in their joints a want of hinging, in their articulations a looseness, very remarkable. Their arms swing, their legs shuffle along, and, as their bodies seem callous, their minds seem inert. They appear wholly incapable of deep abstraction. Nowhere have they, through an innate force, and unassisted by the prior examples and precepts of white races, attained any degree of advancement in science, or of refinement in art. As in every thing the opposite extremes ever precede the just medium, negroes are in their own native regions still ever found either wholly unshackled by any social control, or smarting under the lash of the most unmodified despotism. They either recognise no bond of union, or obey with the most abject submission the most unbridled tyrants. They either live wholly unawakened to any sense of superhuman guidance, or they exhibit the most senseless superstition and faith in the silly tricks of sorcery. Their worship is only a worship of fear: it is only addressed to spirits of evil, whose wrath they strive to avert merely by streams of blood. They have not yet a religion of love, a reverence for an author of good, whose favour is only to be gained by rooting out the ill propensities of the heart. Ages roll over their monotonous existence without producing in their mind the least cultivation, in their manners the least improvement.

Even among black races however, though all originally alike produced by, and all evidently only calculated for climates where prevail the extreme of heat, there may already be discerned many degrees of excellence. The highest of negro tribes are in some respects not only equal but superior to the lowest of white races.

There are in Africa, to the north of the line, certain Nubian nations, as there are to the south of the line certain Caffre tribes, whose figures, nay even whose features, might in point of form serve as models for those of an Apollo. Their stature is lofty, their frame elegant and powerful.

Their chest open and wide; their extremities muscular and yet delicate. They have foreheads arched and expanded, eyes full, and conveying an expression of intelligence and feeling: high narrow noses, small mouths and pouting lips. Their complexion indeed still is dark, but it is the glossy black of marble or of jet, conveying to the touch sensations more voluptuous even than those of the most resplendent white.

CHAPTER XXXIX.

Further examples of the differences physical and mental of different human races.

As the examples of the differences between certain human tribes and others lead me to races higher, and having an organization of body and of mind more flexible, I find it necessary more to distinguish the characteristics that are given them directly by mere nature from those which are superadded by later art, since the latter, well conducted, may raise individuals higher above their earlier natural pitch, and on the contrary, ill conducted, may sink them lower beneath their natural standard.

Like the extremes of heat the extremes of cold still have produced human races, pointedly and exclusively adapted to the regions in which they first arose. The Samoyedes seem as little able to support life on the coast of Guinea as the negroes of the Gold Coast seem able to live near the poles. Only the auctothones of the intervening more temperate regions, less distant from either extreme, seem able to a certain degree to brave both the cold of the one and the heat of the other: and even that but imperfectly, as we have found at Sierra Leone. Like the lowest of the tropical races, the lowest of the hyperborean races still seem to show the inferior combination of the elements of which they are composed, in all their forms and habits. The Samoyede still has a skull depressed and shapeless; hair lank, oily and coarse. His dim half-closed eyes form with each other an angle, descending over his flat misshapen nose. His cheek-bones protrude preposterously. His head, seen sideways, rests obliquely on his curved spine. His body is bloated, and his extremities seem consumptive. His arms and legs are crooked and ill formed: they appear the rude performances of some bungling artificer. His stature is squat and dwarfish; his complexion swarthy; his skin from infancy so shrivelled that before he attains manhood he seems to verge on extreme old age. The female is only distinguishable from the male by her dugs, which hang down to her navel, when not flung over her shoulders, in order to support the infant suspended from her back. Feasting on the remains of the dead whales cast on their shores, the Samoyedes, like their dogs, growl when approached during their meals, and, like dogs, approach their own females for carnal purposes in the sight of strangers. Their short summers they waste, when they can, in intemperance: their long winters they sleep away. The smallest opposition to their momentary whims renders them furious; the weightiest considerations of future welfare hardly make them stir a step. Frightened at a shadow, their cowardice equals their irritability. Of human laws they are ignorant: of divine laws heedless. Their deity is a black cat; their worship, the slaying of their cattle and captives. So unsuited is their frame to any climate milder than their own, that even the temperature of Denmark and Norway is to them mortal.

In the new as in the old world there still remain vestiges of nations which bear the marks of original inferiority of organization, variously modified, strong upon them. Among these are the red or copper coloured tribes, of which some are also found in Africa. So torpid are in some of these, and especially in the Caraibs, the vital functions, that they can for whole days remain deprived of food, ere the cravings of hunger induce them to make the least exertion for the purpose of seeking sustenance, though, when food is at hand, they gorge till repletion alone forces them to leave off, and to lie down motionless till digestion is performed. As slow in their productive as in their consuming powers, their sexual frigidity at first excited the wonder of the more ardent Spaniards. Only capable of being stimulated to exertion by a present bodily stimulus, they are unable to be, by the mere recollection of the most pinching past wants, made to guard against future privations. Only having advanced to the most primitive arts of hunting and fishing, they disdain the labours lighter but more regular of the shepherd and the husbandman. Consequently they by turns lie in complete torpor, or endure the utmost fatigue: alternately suffer the extremes of want, or wallow in beastly excess. At a single meal they consume the provision of a month, and are content to pay for their intemperance by as long a period of abstinence. In the morning, on rising, for an intoxicating draught they give away the mat which on going to sleep they will again want: when unengaged in the chase, or in warfare, they sit for whole days close huddled together in a circle, not for the sake of society, or mental companionship, but for that of mere bodily warmth; as silent and indeed as solitary as if they were alone. There is between them only physical contact, not intellectual communication, interchange of ideas. Their eyes are fixed on vacancy: their intellects in abeyance. Unheeding passing objects, however new and strange; inaccessible to curiosity and wonder, however little they know; incapable of any real merriment;—from mere absence of thought, seeming absorbed in deep cogitation,—they only awake from total apathy to give way to the most sudden and extreme irritation. They pass, without any ostensible reason, from the apparent gravity of the sage to the groundless laughter of the infant. They sometimes bestow on worthless trifles the admiration they withhold from real wonders. If they recognise a Providence it is only in evil. For the performance of no deed, however kind, do they feel any obligation, or return any thanks. How should they? They cannot conceive a desire to oblige. They only fancy man to give away what he wants to get rid of, what he finds it a trouble to keep. But while no favour bestowed excites in them any gratitude, the least boon denied provokes their utmost wrath. Desiring no applause, they fear no disgrace. They know not the value of virtue, of truth, of honour, of renown. They thieve, they lie, they are faithless without remorse and without shame. They are unable to compass abstract ideas of number or of quantity. The least process of addition or subtraction exceeds their mental faculties. Their hardly articulate language only affords words for a few concrete ideas. In their wilds, which, however extensive, are hardly able to supply the restricted wants of a thin population, each new comer is looked upon as an intruder, and treated as an enemy. Each tribe, however small, regards each other tribe, however distant, with hostile eyes. Each tribe even regards its own members who no longer can contribute to the general defence, as no longer entitled to the general protection: as lapsed from their former privileges, as having become a mere encumbrance, as only fit to be spurned or be despatched. Between two different tribes, any meeting, avoided as long as possible, when no longer to be averted, becomes a fight: not indeed in the open field and by fair warfare, but in ambush and by treachery. Prisoners are devoted to a lingering death; and the hardihood with which torture is endured, only proceeds from the hopelessness of inspiring pity. On their wives they never bestow the least endearment, on their offspring any correction. Their companions ill or wounded they leave behind. Their parents when old and infirm they drive away, to die deserted. A life of distrust and suspicion is early closed by a miserable death: for while the African black, like the spaniel, thrives in slavery, and fawns upon his tyrant, the copper-coloured American, like the hyæna, cannot be tamed or brook a master. The small number of those that still prowl about their wastes diminishes daily; and soon the vast continent of America will be entirely stripped of aboriginal races.

America, however, seems to have spontaneously produced races more finely organised than the Caraibs. To the south of the line, in the vicinity of Rio de Janeiro, are still seen those Indians of Tamoy, whose bow no European can bend; across the inland plains of Patagonia still roam those tribes that by their size make the tallest European look diminutive. Before America was remodified by the arts of Europe, it brought forth, from its native exuberance, large cities and flourishing empires. Of some of these the European invaders accomplished the fall: of others the sun had again set even before these strangers appeared. Of such we find the remains on the borders of the Mississippi and in the province of Quito. It does not however appear that the sciences or even the arts ever attained among the Americans a very great degree of eminence. All the gold they possessed still left them destitute of coin, all the languages they spoke, of writing. They used for representing their thoughts none but symbolical signs. In their most civilized states government still remained an unmodified despotism; religion a senseless and sanguinary idolatry.

It is of Asia that the high central table-lands, the outskirts every way slanting down to the surrounding seas, and the far-spreading islands, seem to have produced the human races most different in their organization, most distant in their faculties of mind and body. Among these races, already very superior both physically and morally to those described as having arisen at its Austral Asian extremities, are the more central Mongul race. Still do its individuals yet preserve many marks of inferiority. Their enormous cheek-bones often give their flat faces a width exceeding their length. Their obtuse os frontis and shaggy eyebrows completely overshadow their small piercing eyes, of which the long close-drawn lids descend obliquely toward their small depressed nose. Their organs of smell hardly rise to the level of their large and skinny lips, which extend the whole width of their ample and projecting jaw. Their enormous hemless ears stand out at right angles from their ill-formed head, while their small receding chin is only decked with a few coarse bristles. Their contracted brains do not prevent the thickness of their skull from giving a preposterous size to the circumference of that head, which the shortness of their neck keeps wedged close within their huge elevated shoulders. Their bulky body, ill supported by meagre and bandy legs, seems almost by nature itself so formed as to need the assistance of that equestrian life, which their native steppes so particularly favour. To the Tartars they owe their written language, to the Thibetans their creed; and however long they have had the physical peculiarities of their frame remodified by intermarriages with other surrounding races, less marked by the hand of nature, these peculiarities are so tenacious, that their descendants still retain the impress of the Mongul features.

The Chinese still display the same aberrations of form, but in a milder degree, and therefore are supposed to be descended from the Monguls: but why may they not spring from primitive parents distinct from those of the Monguls, which only from having arisen in a soil and climate nearly similar, have thence alone derived an organization naturally very similar? If the Chinese, though resembling the Monguls, seem to excel these in mental faculties, the Japanese again, in their turn, seem equally to resemble, and yet in energy of mind far to surpass the Chinese.

I shall not pursue any further my examples of races, higher than those described, and yet in their qualities physical and moral short of the very highest races; like that of the Malays, the Indians, the Arabs and the Copts. All of these alike still prove their inferiority to the higher exemplars, by certain features either too long or too short, too full or too meagre, too protruding or too depressed, to preserve the exact middle line compatible with the highest degree of utility and of beauty. All of these alike, by complexion too uniformly light or too uniformly dark, seem to want in their countenances that variety and contrast of hue, which marks the most perfect mixture of the different elements that compose the human frame.

The races which by nature seem most gifted with these qualities seem to have arisen in those regions to the south-west of the Caspian and of Caucasus, where Xenophon still beheld pleasure-gardens similar to that of Eden, the first cradle of the first scriptural pair, and bearing like that the name of Paradise. They seem to have arisen in those regions where, after the deluge of Noah had overwhelmed the surrounding land, the ark first touched ground on Mount Ararat; where rose near the Euxine that city, from the anchor found embedded high up in the neighbouring mountain, called Ancyra; where in later eras on the rocks of Samothrace still remained marks of the deluges of Ogyges and Deucalion; where alone the cereal plants, since diffused over a great part of the globe, first were by nature spontaneously produced; where arose the first great postdiluvian monarchies of Armenia, Persia, Assyria and Media; where originated the most ancient and wide-spreading language on record, that Pahli, the mother of the Sanscrit, the Greek and the German; where Babel's tower since passed for the central point whence diverged in different directions tongues wholly different; where first prevailed that earliest and simplest deviation from the pure worship of the Creator himself, which still had for its object his earliest and most general creations, ethereal fire and its first offspring the heavenly bodies; where to the last the kings of Media, of Persia and of Pontus still had the symbols of this fire worship displayed on their mitres and impressed on their monuments; whence through the regions of Colchis, round the northern shores, and through Pontus, round the southern coasts of the Euxine, seem to have travelled westward those tribes which, settling further down on the opposite continents of Europe and of Asia, and in the intervening islands of the Archipelago, bore the earlier different appellations of Hellenes, of Pelasgi, and others, which at last were confounded in the more general denomination of Greeks; and became that of the people most eminently gifted of which records have survived the wrecks of time: where to this day specimens of the physical perfection of their first ancestors still are beheld in the population of Circassia, Armenia and Georgia, still reckoned the handsomest of the human race.

Those Greeks who in their own original nature must have found the models of those pre-eminent forms of which their art offered the imitation, and of which their degenerate descendants only present the partial remains, mixed with baser alloy, and defaced by subsequent corruption, must in their primitive state have possessed the highest organization of body and the highest capabilities of mind. They formed the races who in the shortest limits of time, and in the smallest circumference of space, with the least assistance from foreign example or tuition, made in art and in science the furthest strides in the most opposite directions: who in natural powers of body and of mind must most have excelled all other later nations which, with the benefit of their example and their precepts as guides, have still only gone beyond them in those acquirements which mere time suffices to mature and perfect, and which to this day are forced to acknowledge their by-gone pre-eminence in whatever is the spontaneous offspring of innate genius and talent.

In the representations of the ancient Greeks we find the skull most rounded, the forehead most square, the brow most sharp, the nose most removed both from the aquiline and snubbed extremes, the lips most wavy, most curling up, most neatly hemmed, most luxuriantly pressing on each other; the chin most convex, the outline of the face most oval, most distant alike from uniform width and from unvaried elongation, the throat most developed in its forms and disengaged in its movements, the chest most ample, elevated and roomy, the waist of slenderest span, the extremities most taper, of any race. We find the skin represented as having its transparent white at its surface most marked by the purple meandering vein, at its extremities most blending with the rich crimson of the blood; the lips tinted with the richest coral hue; the long silken hair most neatly implanted, and most distinctly defined by its auburn or jetty hue; under eyebrows most arched, most confluent and most carefully penciled, and eyelashes casting underneath the softest and most vapoury shade, we find the eyes most full, most resplendent with a lambent fire. We find a countenance most lofty, radiant and animated; a gait most elastic and firm; movements most easy, varied and replete both with vigour and with grace; and when from the contemplation of the qualities that strike the sense we pass to those only cognizable to the mind, we find symptoms of that mental aptitude to every pursuit of art and of science, the most varied and the most opposite, which, by its transcendency justified, over other nations, called barbarians, the pre-eminence universally allowed to the Greeks.

Still do even the Greeks themselves seem not entirely to have filled the full measure of perfection which, under the most favourable circumstances, appears by nature to have been allotted to the organization of man.

Every nation of antiquity, even unto the Greeks themselves, preserved some record of a nation still more highly gifted than itself, which once flourished on the earth, but was subsequently again, in one of those great revolutions which marked the infancy of the globe, swept away from its surface. The Greeks retraced its existence in those Titans afterwards subdued by their gods, and cast into the fiery furnaces of Etna; the Jews recorded its recollection in the rebel angels by Jehovah for their pride hurled into the flames of hell; in those giants, which on this globe are only once mentioned; and in those very descendants of Adam himself, whose longevity, like the size of the Titans, far exceeded the dimensions of later generations; and bespoke a vital energy, since greatly diminished in the postdiluvian races. The Medes and the Persians preserved similar memorials of races gone by, more perfect than any of those remaining, in their Peris, their Dives, their Gin, and their pre-adamite monarchs, also at last for their crimes cast in the regions of everlasting fire.

Even the Hindoo mythology retraced this primitive perfection of human beings in those powerful spirits which, arisen from earth and warring with the hosts of heaven, were at last swallowed up by the very parent from which they had sprung, and, in the deepest recesses of the globe, doomed to eternal flames.

Plato particularly describes as more beautiful in person and more transcendent in intellect than any of the nations remaining on the earth, those Atlantes who probably inhabited the vast inland basin since filled by the waves of the Mediterranean, along whose southern coast still soars Mount Atlas. Having in their pride forgotten that Deity to which they owed their excellence, and having only retained a superiority in vice, their day of final doom at last drew near. When the high waters, long pent up in the table-lands of Asia, whence rivers now flow downwards to every point of the compass, broke their barriers, and in their descent westward successively formed the inferior reservoirs of Lake Aral, of the Caspian sea, the Euxine, the Archipelago, and that last aggregate of internal waters, shut out from the vast ocean by the Straits of Gibraltar, called by pre-eminence the Mediterranean, together with the intervening steppes and plains of salt, these Atlantes were at last, with their country, for ever swept away from the face of the earth.

CHAPTER XL.

After substances, before fluid and inorganic, had been combined together into bodies organized vegetable and animal, unto the highest, that of man, they again, on decombining and reissuing from these bodies, are separately recombined into other bodies organized vegetable or animal, later but less complex than the former.

We have seen that substances, first fluid and inorganic, are by degrees combined in bodies merely vegetable or also animal, unto those of the latest and highest species we know, those of the most exalted human beings; but as life consists of elements constantly from fluid combining into solids, and from solids again decombining into fluids, these elements which in one form are combined into living solids, may, on again dissolving and issuing from those solids, anew be, even while the collective life of the former individuals lasts, recombined in another form; and in proportion as more different elements have been combined in different organs and parts of the same single connected individual, of these different elements, from the different organs and parts of that single individual again, whether in the healthy state of that individual, or when it becomes diseased, or again when dead it entirely decomposes, issuing, each may afresh with certain others from without be recombined into other individuals of later and lesser species, again different from itself, and from others partly composed of its other emanations—namely, the emanations issuing from vegetables into other vegetables and animals, and those issuing from animals into other animals and vegetables, partly composed of its prior elements, but again more subdivided among different lesser individuals; always supposing that these elements from within the former body issuing, are by new elements from the atmosphere without so met, resisted and prevented from evaporating, as with these to be recombined into those new organic entities; since, where such communication of the elements from within the body issuing, with such new elements from without remixing with these, does not and cannot take place, no such new creations ensue;—since an unimpeded communication with the atmosphere is indispensable to their arising.

Not only bodies organized but even bodies still inorganic produced by nature, may, on being again decombined and recombined with elements from without of different sorts, again be recombined into more complex organic bodies. The very air we inhale, the very water we drink, when their different component elements by decomposition lose their balance, may with other elements be recombined into certain vegetable and animal forms of fungi and of aphides floating in air, and, as they grow more large and weighty, alighting on more solid substances and bodies. Wood decomposing may produce its dry rot, and flesh its maggots. Nay, even fluids and solids, compounded by human art—wine, beer, vinegar, cheese, parchment, leather and others, when again decomposing in free surrounding atmosphere, may produce some mould, mildew, maggot, or other sort of secondary vegetable or animal, not elsewhere found.

Thus arose a few years ago round London, on all the apple and pear trees, no doubt from a new remodification of its atmosphere, a new species of coccus, never seen before, which I believe had only a short existence. Thus out of mere dung, in certain situations fermenting, spring up edible mushrooms. Thence it is that, when a body vegetable or animal dies, and with it leaves to die the minor bodies, formed of different parts of its exsudations, which only lived on its life, there arise out of its remains other new fungi and new worms more hastily and copiously formed, which, as soon as the source of their subsistence from within is exhausted, also again in their turn fall, and add their component fluids to the stock of those that, returning to the general mass of the earth, again become able to serve as materials for, and are imbodied in new productions, vegetable and animal, of a higher sort.

These secondary living entities, out of the emanations of former entities from within, remixed with new elements from without, composed, are called parasites. As primary entities, vegetable and animal, are themselves larger, richer and composed of materials and parts more different from each other, they enjoy the unenviable privilege of being able in their turn to produce, feed and support parasites more numerous and more varied.

These parasites, from their commencement only able in part to subsist on the superfluities of their supporters, may grow till they rob these supporters even of their necessaries; till they rise on their ruin, and till their thriving produces the exhaustion, decay and death of the very foundation on which they rose.

There is not a mould or mildew so insignificant, a zoophite or polypus so mean, that is not able to give birth to some parasite still less than itself; that may not in its turn become the soil, the parent, the supporter of some fungus or animalcule, of which thousands may crowd on its surface. Of each vegetable larger, more important, and composed of substances and parts more varied, each sap and each organ, the cotyledon, the roots, the branches, the core and the bark, the foliage, the flower and the fruit—of each animal more extensive and combined of elements more diversified, the egg, the parts and organs lymphatic and chylous, the blood veinous and arterial, the forms internal and external, the bowels and the skin, the organs vital, sensitive and intellectual, unto the very brain,—have each their parasites, some remaining for life immured in the parts in which they first were formed, others by degrees working their way out of these, and at last appearing undaunted in the broad face of day. Some are so small that to them a drop of lymph or blood is an ocean, that they swim in shoals through every duct and channel; and all naturally partake so much of the nature of the elements of which they are formed, that the very vermin born and bred on the body of a negro differs from the parasite that infests the person of a white man, who takes not care to wipe off his exsudations before these are, with new elements from without, combined into new living entities.

Nay the very parasites, vegetable or animal, of higher vegetables and animals, may in their turn again become the soil and cradle of other lesser parasites, vegetable and animal, to whom the former are what the oak is to the mildew, or the elephant to the flea. Of these some are so small, so imperceptible, that their very minuteness protects them from our grasp; that we may all our lives be compelled to feed, to support, to shelter, to carry them about on our bodies, without so much as being able to brush off, or even to recognize the population of which we are the parents.

Life thus, as long as it continues to be limited to this globe, to its atmosphere and to its soil, may only seem to move in a constant circle, from its most inferior commencement rising to its higher modifications, and from these again reverting to the lower ones. It is only when it breaks through the magic circle, when its elements burst athwart the spell that surrounds them, when they soar to higher regions, that in these regions they find room for combinations more extensive and more lasting.

CHAPTER XLI.

Reasons why the words of Scripture should be taken more literally than they generally are, when it says that the first man arose out of the dust of the earth.

I HAVE thus far only given a sketch of the first creation and further development of such entities organic and living, vegetable and animal, from the lowest to the highest, as, however much they might in their turn again procreate later entities of the same species, did not themselves first arise out of earlier ones of the species; as were all still only primary individuals of their species. I have, however, described these entities as in their whole only arising out of prior elements, animal, vegetable and mineral already collected on the surface and floating in the atmosphere of this globe; and not as arising, in the way people in general seem to believe the thing to have happened, out of nothing material previously existing, and by mere miracle.

This belief I entertain, not in consequence of any reluctance I feel to the other contrary opinion of their having arisen out of nothing material previously existing, as holding out an event in itself too wonderful to credit. It is equally wonderful that prior inorganized matter should have received from God the capability of being formed into the first organized bodies, as that such bodies should have been formed directly out of nothing prior; but the former is a wonder less disconnected with, less detached from, less in opposition to, more in unison with, more directly and naturally proceeding out of all the other former wonders of the creation, and more in its turn leading to all the other later wonders of that creation, than the latter: it is even more conformable to the words of Scripture itself, where it expressly says that man was created, not out of nothing material and cognizable prior to himself, but out of the dust of the earth; which can only mean the elements afforded by this earth, and by its surrounding atmosphere, before these were reduced to a state of combination, organization and life.

The time is in fact gone by for maintaining with Bonnet, and other naturalists of the last century, that all that has life can only proceed out of what lived before, till we ascend to the first living individuals of each species; and that these could only have been produced out of nothing prior that was not living,—could only have been produced by mere miracle.

Do we not even to this day, in the last and highest of organized and living entities, in man, see new forms, organs and faculties of mind, not existing before, arise and be developed in his body, in his vital parts, out of the combination of elements taken in from without, which before had all only hovered in air or lain on earth, in an uncombined and unappropriated state? If we have shown that all the faculties of the mind, as well as those of the sense, and those of mere insentient vitality, must be founded on peculiar material organs, and that all material organs must be combined out of elements, before in an uncombined and unappropriated state floating around, it cannot be denied that only out of elements from without, first uncombined and unappropriate, these organs can be subsequently composed.

Do we not in the same way to this day see the mere organs of vitality, on which those of sense and intellect must afterwards be founded, every where by new elements from without, before uncombined and unappropriated, in their turn formed and developed?

And if, while in man, and in the higher brutes and higher vegetables, we only every day see the later increase and development of the first organs, derived from elements taken in from without in an uncombined and unappropriated state—if in these entities we do not see, out of elements from without driven together, the first foundation, formation, combination and appropriation into such organs, of entities organic and living less important—of lychens and of worms—of mollusca and of zoophites—may we not in a manner see the very first commencement and formation, arising out of the meeting and combination of opposite elements from without, before uncombined and lifeless, which from surrounding air and water are supplied?

Do we not in every region, where no prior germs of any living and organized entities could have previously existed, or whither none such could have been conveyed from elsewhere—which, for instance, has just for the first time emerged from the bosom of the sea, at an incalculable distance from any surrounding land, whence the germs of such entities could have been wafted to it,—by degrees in the exact proportions suited to their later development become covered with all the lower species of vegetables and of animals, to which its aspect, its climate, its situation and its soil—the peculiar elements aërial and terrestrial fitted to compose and support such entities—rendered it suitable? and these precisely at every place and at every time, of the sorts and in the proportions, in which its peculiar elements render it capable to produce such; without leaving the possibility of rationally believing that the germs of these entities have been brought, ready formed, from other regions?

Nay, do we not in their turn see those primary organized entities, thus out of nothing organized before, but out of mere inorganic elements combined, in their turn, while healthy, from their own emanations, recombined with new elements from air and earth without, produce within their body and at their surface parasites, vegetable and animal, even more still than themselves soaring beyond all suspicion of having had their germs, ready formed, brought from elsewhere?

Do we not see when of a region or site, the elements, the atmosphere, the climate, the soil or the situation undergo a change—when they afford elements different from those they afforded before, this region, this site, without any interference of man or beast, again change the nature of its indigenous productions, vegetable or animal? and when the interference of man or beast again changes the thus far inorganic and inappropriated elements of the soil, do we not again see other new species, organic and living, vegetable and animal, of which no preformed germs have been from elsewhere there deposited, arise at the exact time, in the exact place, and in the exact proportion in which these causes would spontaneously have produced these effects?

Do we not already see when mere inorganic substances become disturbed, when air is decomposed by a blight, when water is left to stagnate and to become putrid, new recombinations produce new entities organic, vegetable and animal—new mildews, new aphides unheard of before?

Do we not in the same way see vegetables and animals, when they become diseased—when they exsude saps different from those which they exsuded in health—by the recombination of these new substances from within with new elements from without, produce new sorts of entities, vegetable and animal, different from those they produced while in health? Do we not in the same way again see when vegetables and animals entirely die—when all their component parts alike decombine, out of the decombination of these arise new entities, new fungi and new worms, of which no trace was discoverable in them while alive, provided only on decombining they have communication with air, and recombine these effluvia with elements from that air?

Do we not see even vegetables and animals arise, which having no forms, no faculties of procreation, and thus, not arising out of earlier entities of the same sort, can only to the present day in their whole arise out of prior inorganic matter; unless indeed the miracle of their arising out of nothing prior be every day every where repeated and renewed?

And can we thus, without entirely departing from all the rules of belief and credibility, refuse believing that at least certain entities organized, living and sentient, can at least have their combinations produced out of elements before inorganic, uncombined and lifeless?

Nay, can we draw a line? can we refuse to believe that all entities organic and living without exception, even the highest, man himself, may not, must not, have arisen in this way, at first, and while by the non-appropriation of any elements into prior human beings these elements still remained in the greatest abundance and closeness, ready to be thus united; rather than that by miracle they should have arisen out of nothing previously existing, when those elements themselves in their turn still remained thus far uncombined, and where only at a later period taken in and appropriated by those human beings?

Can we suppose that it was not, on the contrary, in consequence of these unappropriated elements every where, as soon as they arose in sufficient quantities, sufficiently near to be combined together, being so immediately combined into the entities to which they were suited, as afterwards only to leave these entities already combined, themselves able through the medium of their own reaction from a further distance to attract the elements unappropriated more rare that still remained, or that were through the decombination of former ones again reproduced, and re-emitted in circulation, that, where a certain quantity of these elements had already been spontaneously combined, directly out of more inappropriate elements, later ones of the sort were only permitted to be combined through the medium of the more powerful attraction of these former ones already combined?

That thus, in regions already peopled by the higher entities, who require for their first formation materials more varied and more copious, there is no chance of such fresh combination taking place by mere chance out of the approximation of the necessary elements, without the intervention of prior individuals of the sort.

And that only in regions newly emerged from the sea, and where spontaneous combinations cannot yet have any witnesses able to vouch for the fact, such can still take place.

Having thus shown how out of elements before on earth and in the atmosphere floating, unappropriated and uncombined, must spontaneously have arisen and been combined the primary individuals of each species organic and living, vegetable and animal, from the lowest moss to the highest man that arose on this globe, I shall now proceed to show how, out of these primary individuals of each species themselves, and through their medium, could be made to arise later ones of the same sort in the way of regular procreation.

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LONDON:
PRINTED BY THOMAS DAVISON, WHITEFRIARS.

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